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VOL. CXXXII.—No. 3424] LONDON: FRIDAY EVENING, AUGUST 12, 1921 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS from such persons as may be willing to SUPPLY TELEGRAPH CABLE.

The conditions of contract may be obtained on application to the Director-General of Stores, India Office, Whitehall, S.W. 1, and Tenders are to be delivered at that office by Two o'clock p.m. on Tuesday, the 30th August, 1921, after which time no Tender will be received.

G. H. COLLIER,
Director-General of Stores.

5849

Draughtsman Required by the GOVERNMENT of the GOLD COAST for RAILWAY CONSTRUCTION, for two tours, each of not less than 12 nor more than 18 months' continuous service. Salary £400 a year. Outfit allowance of £60 paid on first appointment. An allowance of £60 a year additional to salary is paid to married officers during the year 1921. Free quarters or a field allowance in lieu at the rate of £7 10s. a month. First-class passages provided. Liberal leave in England on full salary.—Candidates, not over 45 years of age, who must be good Draughtsmen, with considerable experience in an Engineer's Office, preferably on Building Construction, should apply at once in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Gold Coast 10,989. 5822

University of Birmingham.

FACULTY OF SCIENCE.

ENGINEERING DEPARTMENTS.

I.—MECHANICAL ENGINEERING.
Chance Professor: F. W. BURSTALL, M.Sc., M.A. (Cantab), M. Inst. C.E., M. Inst. M.E.
Lecturer: R. C. FOSTER, M.Sc. (Vict.), A.M. Inst. C.E.
Demonstrator: S. J. ELLIS, A.M.I.C.E.
Lecturer on Machine Design: F. H. BODEN.
Assistant Lecturer on Machine Design: HENRY BAKER, B.Sc.

II.—CIVIL ENGINEERING.
Beale Professor: FREDERICK C. LEA, M.Sc., D.Sc. (Lond.), A.M.I.C.E., A.R.C.S.
Lecturers: R. C. PASTON, M.Sc.
E. E. STRADLING, B.Sc., A.M.I.C.E.
H. W. COULTAS, B.Sc.
Lecturer on Town Planning: W. HAYWOOD.

III.—ELECTRICAL ENGINEERING.
Professor: WILLIAM CRAMP, D.Sc.
Lecturer: E. J. KIPPS, M.Sc., M. Inst. E.E.
Assistant Lecturers and Demonstrators: O. E. RANDALL, B.Sc.
H. VICKERS, M.Eng.
G. M. HARVEY, B.Eng.

The FULL COURSES EXTEND OVER FOUR YEARS, and Students who enter after Matriculation and pass successfully the Examinations at the end of each year will be ENTITLED TO THE DEGREE OF BACHELOR OF SCIENCE in Engineering.

The SESSION 1921-22 COMMENCES on OCTOBER 3rd, 1921.

For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the SECRETARY. 5715

The University of Manchester.

DEPARTMENT OF ENGINEERING.

The Council is about to proceed to the APPOINTMENT of an ASSISTANT LECTURER in ENGINEERING and INSTRUCTOR in DRAWING, who would be expected to enter on his duties on September 29th, 1921.

Salary £300 per annum. Further particulars may be obtained from the Internal Registrar. Applications, giving three references, should be sent to the INTERNAL REGISTRAR not later than August 29th. Testimonials (one copy of each, which need not be printed) may be submitted. 5851

The University of Sheffield.

FACULTY OF ENGINEERING.

APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER in MECHANICAL ENGINEERING.

Salary £400 per annum, including evening work during Winter Session. Candidates holding a University Degree with Honours in Mechanical Science preferred.

Applications, stating particulars of training and experience, accompanied by three testimonials, should be sent not later than August 20th to the undersigned.

W. M. GIBBONS,
Registrar.

5672

University of London, University College.

APPLICATIONS are INVITED for the POSITION of SENIOR ASSISTANT in the Department of Civil and Mechanical Engineering, which is under the direction of Professor E. G. Coker. The work requires training and experience in Engineering Design and Drawing-office practice.

Salary £450 to £500 (pensionable), according to qualifications and experience. Further particulars may be obtained from

WALTER W. SETON, M.A., D.Litt.,
Secretary.

University College, London
(Gower-street, W.C. 1). 5784

County Borough of Wallasey.

NEW BRIGHTON LANDING STAGE RECONSTRUCTION.

The Corporation of Wallasey invite TENDERS for the SUPPLY and DELIVERY of 12 CAST IRON COMPRESSORS with STEEL TIE RODS and PLATES for the attachment of Landing Stage Moorings for the above, in accordance with the detailed plans and specification prepared by Messrs. Wilton and Bell, Consulting Civil Engineers, Westminster Chambers, 1, Crosshall-street, Liverpool. Plans and specification may be seen at Messrs. Wilton and Bell's offices by appointment, and contractors desiring to obtain copies of the plans may do so on payment of £1 1s. Tenders, on the form of Tender provided, must be delivered to the undersigned in a sealed envelope, endorsed "Tender for New Brighton Landing Stage Compressors," not later than Noon, Saturday, September 17th, 1921.

GEO. LIVSEY,
Town Clerk.

Town Hall, Wallasey,
2nd August, 1921. 5792

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Improvement in Methods of Fatigue Testing.

New British Naval Construction.

A Large Leeds Foundry.

Modern Marine Diesel Engines—No. VI.

The Steam Locomotive of the Future.

Friction Tests of Bearings.

Developments in Power Station Design. No IV.

Openings for Machinery in Spain.

A New Electric Spot Welding Machine.

PUBLIC NOTICES

County Borough of Wallasey.

SEACOMBE FERRY IMPROVEMENTS.

The Corporation of Wallasey invite TENDERS for the CARRYING OUT of that portion of the above work denominated Work "A," which comprises a NEW FLOATING GOODS LANDING STAGE, approximately 320ft. in length and 80ft. in breadth, and works in connection therewith, in accordance with the detailed plans and specification of Messrs. Wilton and Bell, Consulting Civil Engineers, Westminster Chambers, 1, Crosshall-street, Liverpool, the Engineers for the work, at whose offices copies of the plans and specification may be seen. Contractors desiring to obtain copies of plans and specification may do so on payment of £5 5s. Tenders, on the form of Tender provided, must be delivered to the undersigned in a sealed envelope, endorsed "Tender for Seacombe Ferry Improvements, Work 'A,'" not later than Twelve Noon, Saturday, October 15th, 1921.

GEO. LIVSEY,
Town Clerk.

Town Hall, Wallasey,
2nd August, 1921. 5793

Stone Urban District Council.

TO BORING CONTRACTORS.

The above Council invite TENDERS for SINKING a 21in. to 12in. BORE-HOLE, 500ft. deep, at their Waterworks.

Specification and form of Tender may be obtained from Mr. R. C. Frais, M.I.C.E., 89, Albion-street, Hanley, Stoke-on-Trent, on payment of £1, which will be returned on receipt of bona fide Tender.

Tenders, endorsed "Tender for Bore-hole," must be received by me, the undersigned, on or before Saturday, 20th August.

The Council do not bind themselves to accept the lowest or any Tender.

CHARLES H. MATTHEWS,
Clerk to the Council.

Westbridge House, Stone, Staffs,
30th July, 1921. 5776

TO FIRMS WANTING CONTRACTS.

Tenders are Invited from Large and Small firms for the Manufacture in various quantities, on a repetition basis, of the following, either separately or collectively:

(1) BRASS DOUBLE-ACTING, HAND-OPERATED AIR PUMPS, 4in. bore by 12in. stroke.

(2) COMBINED DIRECTION CHANGING CONTROL COCK AND SAFETY SWITCH for above (no electrical knowledge required), and

(3) DOUBLE DURALUMIN TANKS in several sizes and with the air exhausted from one chamber.

It may be desirable to allot work to one or to several firms, according to circumstances. Allotment of contracts depends entirely upon terms and the advertiser does not bind himself to accept the lowest or any tender. Complete working drawings, specifications and manufacturing details will be forwarded upon application and payment of the fee of £1 1s., which fee cannot, under any circumstances, be returned.

Applications should be addressed to MR. H. GEORGE HARLEY, Consulting Engineer, at Grand-avenue, Camberley. P5822

FOR SALE.

The Guardians of the Ormskirk Union invite TENDERS for the PURCHASE of ONE 50 B.H.P. NATIONAL GAS ENGINE, coupled to "Witton" Multi-polar DYNAMO, 220 v, 140 a, D.C., 220 r.p.m., which were installed at their institution in 1914.

The above may be inspected, by appointment with the Master, Poor Law Institution, Ormskirk.

Tenders to be in my hands not later than 9 a.m on Tuesday, August 30th, 1921.

ALFRED DICKINSON,
Clerk to the Guardians.

Ormskirk,
August 9th, 1921. 5887

PUBLIC NOTICES

The Madras and Southern MAHRATTA RAILWAY CO., LTD.

The Directors are prepared to receive TENDERS for
(1) MISCELLANEOUS GLASS, &c. (Plate, Sheet, Mirrors, &c.),
(2) FENCING STRAND WIRE, STIFFENING POSTS, &c.,
(3) 72,345 FIRE-BRICKS and 50 TONS FIRE-CLAY,

in accordance with the specifications, which may be seen at the offices of the Company. The charge for each specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, the 16th August, 1921, marked "Tender for Misc. Glass, &c.," or as the case may be.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices,
25, Buckingham Palace-road,
Westminster, S.W. 1,
22nd July, 1921. 5863

County Council of Sutherland.

COUNTY ROAD SURVEYOR AND ASSISTANT SURVEYOR WANTED.

The County Council of Sutherland invite APPLICATIONS for:—

(1) The OFFICE of COUNTY ROAD SURVEYOR. Salary £425 per annum; actual travelling expenses; office, posts, and stationery; and an allowance of £80 for clerical assistance; and

(2) The OFFICE of ASSISTANT ROAD SURVEYOR; salary £225 per annum and actual travelling expenses.

Applications, stating qualifications and age, accompanied by 33 copies of testimonials and of application, must be lodged with the undersigned on or before 3rd September, 1921.

For further particulars apply to the undersigned.

ARCHD. ARGO,
County Clerk.

County Clerk's Office,
Golspie, 6th August, 1921. 5880

The Sudan Government Railways and STEAMERS DEPARTMENT REQUIRE the SERVICE of THREE FOREMEN FITTERS. Starting salary, £E300 to £E324, according to qualifications, plus a temporary war gratuity of £E120 per annum.

Strict medical examination.

Applicants should be trained in Locomotive Work and have had subsequent Running Shed Experience, and also some technical qualifications.

Age 25-30 years; preferably single.

The posts are progressive and pensionable after satisfactory probation.

ONE ENGINEERING FOREMAN. Starting salary £E360 per annum, plus a temporary war gratuity of £E120 per annum.

Applicants should have had special training in Machine Shop Practice and Fitting. Experience in Smithing and Moulding would be considered an added qualification.

Strict medical examination.

Age 28-34; preferably single.

The post is progressive and pensionable after satisfactory probation.

ONE STEAMER ENGINEER for Nile Shallow-draught Steamers.

Salary £E300 per annum, plus £E120 war gratuity.

Strict medical examination.

Age 26-32; preferably single.

Applicants for the post should possess a Second-class B.O.T. Certificate.

The post is progressive and pensionable after satisfactory probation.

All applications should be addressed to the INSPECTING ENGINEER, Egyptian and Sudan Governments, Queen Anne's Chambers, Broadway, Westminster, S.W. 1, and the envelopes marked "Foreman Fitter," "Engineering Foreman," or "Steamer Engineer." 5885

PUBLIC NOTICES

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

	Specification Fees.
1. STEEL WORK for BRIDGES	£1
2. LAMINATED SPRINGS	£1
3. STEEL SCREW COUPLINGS, &c.	£1
4. CRANK AXLES and STRAIGHT AXLES	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Steel Work for Bridges," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 23rd August, 1921.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 10th August, 1921. 5891

PATENTS AND DESIGNS ACTS, 1907 and 1919.
WIRE-STITCHING AND STAPLING MACHINE.

The Proprietors of British Letters PATENT No. 117,946 are PREPARED to SELL the PATENT or to LICENSE British manufacturers to work under it. It comprises means for adjusting the stitching mechanism and work support according to thickness of work and also regulating the action of staple-forming and driving mechanism.

Address, BOULT, WADE and TENNANT,
111 and 112, Hatton-garden,
5853 London, E.C. 1.

PATENTS AND DESIGNS ACTS, 1907 and 1919.
ELECTRIC WELDING.

The Proprietor of British Letters PATENT No. 111,088 is PREPARED to SELL the PATENT or to LICENSE British manufacturers to work thereunder. It relates to the manufacture of flanged tubes by electric welding. The proprietor is also prepared to deal in like manner with British Patent No. 111,089, comprising an electric seam welding machine, wherein the feed of the work is in direct proportion to the current flowing to the joint.

Address, BOULT, WADE and TENNANT,
111/112, Hatton-garden,
5854 London, E.C. 1.

The Proprietor of Letters Patent No. 18,830/13, relating to "INTERNAL COMBUSTION ENGINES," DESIRES to DISPOSE of his PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the Patent in this country.

Inquiries to be addressed to—
CRUIKSHANK and FAIRWEATHER,
65-66, Chancery-lane,
London, W.C. 2. 5868

The National Foremen's Asso- CIATION of the ENGINEERING AND ALLIED TRADES.

(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity. All communications to Head Offices,

H. W. REID, 95, Belgrave-road,
General Secretary. Victoria, S.W. 1.
Ex.

PUBLIC NOTICES (continued) Page II.

SITUATIONS OPEN

WANTED by a Leading Boiler Insurance Company, additional BOILER INSPECTORS. Applicants must be practical Engineers with a technical training, capable of Making accurately dimensioned Sketches of all classes of Steam Boilers and of Writing Clear Reports on conditions. Commencing salary £360 per annum, rising by annual increments to £400 per annum.—Address, 5832, The Engineer Office. 5832 A

WANTED, THREE SHIFT ENGINEERS for Power Station in Fife; must have had experience with Babcock and Wilcox Boilers, Stirling Boilers and High-pressure Turbines. Only men having Power Station Experience need apply. State age, experience and wages required.—Address, 5840, The Engineer Office. 5840 A

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SITUATIONS WANTED Page II.

MACHINERY, &c., WANTED Page IV.

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SITUATIONS OPEN (continued)

CIVIL ENGINEERS REQD. for Abroad, with Exp. of Railway Construction or Roadmaking; single pref., age 25/35; Sal. £400/800, quarters, &c.—Apply, LAURIE and CO., Employment Specialists, 23, Basinghall-st., E.C. No preliminary fee. 5802 A

ENGINEER (Practical) WANTED, to Take Entire Charge of Boilers, Economisers, Quick-speed Engines, and Turbo Set, A.C. and D.C. Generators and Motors, Shafting, Gearing, &c., in a Large Textile Works. Should be a fair draughtsman and able to lay off buildings and heavy foundations. Ex-Service man preferred.—Address, stating age, experience, and salary expected, P3768, The Engineer Office. P3768 A

ENGINEER-SURVEYOR WANTED by a Leading Insurance Company; 1st Class Board of Trade Certificate and Electrical Experience necessary. Commencing salary £560 per annum.—Address, P3702, The Engineer Office. P3702 A

ENGINEER, Under 22, Unmarried, with Civil, Mechanical and Electrical Experience, WANTED for Persia. Initial salary, 1000 rupees per month, with benefits of Provident Fund and quarters.—State age, education, experience, war service, to STRICK, SCOTT and CO., Ltd., Winchester House, E.C. 2. 5804 A

IN SEPTEMBER NEXT a VACANCY WILL OCCUR (London) for a TUTOR in MECHANICAL and ELECTRICAL ENGINEERING.
The Tutor appointed should have passed the Associate Membership Examination of the Institution of Civil Engineers or the B.Sc. (Engineering), London University.
The work can be done, if necessary, in the evenings, and need not interfere with daily occupation.
Particulars of qualifications and time available should be sent to—
Messrs. H. W. and S. PATEY, Solicitors, 42, Finsbury-square, E.C. 2. P3812 A

MECHANICAL ENGINEER (Age About 35) REQUIRED for Copper Mill in South Ireland; experience in Erecting and Running Internal Combustion (Producer Gas and Oil) Engines essential; knowledge of Electricity an advantage. Free furnished bachelor quarters provided. State salary required, and enclose record of past experience with copies only of more important testimonials—originals cannot be returned.—Address, 5820, The Engineer Office. 5820 A

LONDON REPRESENTATIVE WANTED by a Firm of Constructional Engineers in the North, to secure orders for Pit Tubs, Light Railway Stock and Constructional Steel Work. To a suitable man the prospects are very good and a high salary and bonus will be paid. Reply should state in confidence age, experience, references, and suggested remuneration.—Box 286, Willing's, 125, Strand, W.C. 2. 5767 A

MACHINE TOOL SALESMAN REQUIRED; Must be capable of demonstrating and have minute knowledge and connection in definite district. Send details, salary expected, and experience. Knowledge of English and particularly American machines essential.—Address, 5715, The Engineer Office. 5715 A

REPRESENTATIVE WANTED by Old-established Yorkshire firm. State experience, ground covered and full particulars. Good salary and commission to right man. First-class influence and connection with steel works, collieries, and large steam users absolutely essential.—Address, 5814, The Engineer Office. 5814 A

REPRESENTATIVE WANTED to Work Exporters and assist in Export Dept.; correspondence; French an advantage, but not essential, but knowledge of exporters and hardware buyers desirous; sole services. State remuneration required (including commission and expenses), and previous experience.—Address, 5696, The Engineer Office. 5696 A

REPRESENTATIVE WANTED, with Real Live connection among Collieries (one technically acquainted with Colliery Plant), for old-established company in the Midlands; liberal terms.—Address, 5824, The Engineer Office. 5824 A

REPRESENTATIVE. — Well-known Engineering Firm are DESIROUS of APPOINTING RESIDENT TECHNICAL REPRESENTATIVE for Scotland. Remunerative position for live man. Preference given if experienced in Foundry and Smiths' Shop Equipment.—Address, giving full particulars and stating what connection, both with users and retailers, 5589, The Engineer Office. 5589 A

SALES AND ADVERTISING.—WANTED IMMEDIATELY, CHIEF ASSISTANT for SALES PROMOTION DEPARTMENT. Must be able to Write Advt. Copy and Form Letters and able to Prepare Booklets, Catalogues, &c. Drawing-office experience, especially if connected with Piping Systems (Water or Gas Mains, Steam Pipes, &c.), an advantage. Excellent opportunities of advancement for right man. Application must be made in writing, giving age, salary required and details of experience. Any reference copies, specimens of work, &c., submitted will be duly returned after perusal.—
VICTORY PIPE JOINT CO., Ltd., 28, Victoria-st, London, S.W. 1. 5870 A

STEEL CASTINGS. — TRAVELLER WANTED London district, with thorough knowledge of Trade, Markets, &c.—State experience, qualifications, remuneration expected, when free, to JOHN M. HENDERSON and CO., King's Works, Aberdeen. 5874 A

WORKS MANAGER WANTED for Small Modern works; must be good organiser and accustomed to high-class Repetition Work. State age, salary, experience and qualifications.—Address, P3806, The Engineer Office. P3806 A

YOUNG MECHANICAL ENGINEER, who has had good technical college education and actual workshop training of a general character, is REQUIRED for Research Work with Mechanical Engineers. Only applications stating fully detailed particulars of training, career, age, and salary will be considered.—Address, 5813, The Engineer Office. 5813 A

WANTED by a Leading Engineering Firm, specialising in the Manufacture of Coal Cutters and Coal Conveyors, a FIRST-CLASS MAN to Take Charge of Drawing-office; preference will be given to applicants having experience in these specialities. A progressive man with initiative is wanted, having Mechanical and Electrical Knowledge, able to produce deigns in line with modern requirements and modern methods of production. Applicant must state fully age, experience, present position and salary required.—Address, 5842, The Engineer Office. 5842 A

WANTED, First-class ENGINEERING DRAUGHTSMAN, to act as Checker in large Drawing-office. Must be used to Structural and Boiler Detail Work and have held similar position previously.—Address, stating age, experience and salary required, 5821, The Engineer Office. 5821 A

DRAUGHTSMAN WANTED, Up-to-date in Colliery Plant, Yorkshire district; only those giving fullest particulars, age and references entertained. No wasters need apply.—Address, 5823, The Engineer Office. 5823 A

FIRST-CLASS DRAUGHTSMAN WANTED AT ONCE; must have previous experience in Designing Light Railway Wagons, &c. State age, experience and salary required; permanency.—Address, Box 86, Wheeler's Advertising Agency, Manchester. P3786 A

REINFORCED CONCRETE DRAUGHTSMAN, with good theoretical knowledge, capable of Designing and Detailing all ordinary Structures. State salary and full particulars.—SOUTH WALES STRUCTURAL CO., Swansea. 5846 A

PUBLIC NOTICES

JUDICIAL SALE

of assets of

The Dominion Shipbuilding and Repair Company, Limited.

In the matter of The Dominion Winding up Act,
and in the matter of The Dominion Shipbuilding and Repair Company, Limited.

SEALED TENDERS will be received, addressed to J. A. C. Cameron, Official Referee, Osgoode Hall, Toronto, and marked "Tenders in the matter of The Dominion Shipbuilding and Repair Company, Limited," up to Wednesday, the Thirty-first day of August, 1921, for the purchase of the assets en bloc of the above-mentioned Company.

The assets consist of:—

Real Estate Leasehold.

Being part of Block G, according to a plan registered in the Registry Office for the Registry Division of West Toronto, as Number D-1397, containing 13,353 acres, and more fully set out in lease between The Toronto Harbor Commissioners and the above Company, for forty-two years, from 1st July, 1919, at an annual rental of $22,100.00 for the first twenty-one years, and taxes and rates, and for the second twenty-one years, such rental as the premises shall be worth on the first day of July, 1940. This lease also contains a provision for the renewal thereof, at the conclusion of any term of twenty-one years, in accordance with the terms and provisions contained therein. This leasehold land embraces approximately 1868 feet of water front, with 5 permanent shipways, equipped with 3 electrical travelling gantry cranes and 1 set of shear legs 100 tons lifting capacity.

Erected upon the aforesaid lands are three main buildings—

(1) Punch and Joiner Shop: The Punch Shop section is 200 feet by 225 feet, and is made up of 4 bays, each equipped with a 3-ton electric travelling crane, and includes the oil furnace equipment, the bending slabs, the angle iron smith shop, the rivet manufacturing plant, with separate furnace and rivet stores. It is fully equipped with fabricating machinery said to be capable of producing approximately 75 tons of steel per nine-hour day. The Joiner Shop section is 110 feet by 185 feet, and includes the air tool room, the power plant, hospital and lavatories and warehouse, with second floor full length used as a mould loft. These buildings are constructed of structural steel, with reinforced concrete walls, and the Punch Shop section is divided from the Joiner Shop section by an approved fire wall for insurance purposes.

(2) Machine Shop Building is 275 feet by 110 feet, built of structural steel, with hollow tile side walls and built-up roofing. This building includes the pipe shop, with electrical shop and pattern shop overhead, and also the blacksmith and forge shop. The machine shop proper has 3 bays, equipped with two 3-ton and one 15-ton electric travelling cranes. This building is fully equipped with modern and up-to-date machinery necessary for general machine shop operations, but particularly fitted for the production of marine engines.

(3) Main Office Building, 3-storey solid brick building, slate roof, equipped with separate hot water heating. The ground floor takes in the main offices and time office. The second floor takes in Draughting Office, Lunch Room and Janitor's Apartments. The third story is used for a blue printing room and general store room.

The estimated capacity of the plant for shipbuilding purposes is 10 to 12 vessels per year, and is said to be the most modern shipyard in the Dominion.

Power Plant.—The plant is equipped throughout with compressed air developed from the Electrical Power House, said to have a capacity of 4500 cubic feet per minute.

The buildings and plant were erected during 1917–18, and are of entirely new construction representing an investment (inventory value) as follows:

Buildings and yard construction	$637,215.52
Machinery and equipment	932,934.44
Total inventory value	$1,570,149.96

Terms of sale are 25% of the amount tendered on the acceptance of the tender, and the remainder will be arranged on special terms, with seven per cent. interest, secured to the satisfaction of the Liquidator.

Tenders will be opened at the office of the Official Referee on Wednesday, the 31st day of August 1921, at eleven o'clock in the forenoon, and all tenders are requested to be then present.

All tenders must be accompanied by a marked check payable to the Liquidator for 5% of the amount of the tender, which will be returned if the tender is not accepted, and forfeited if the tender is accepted and not completed by the purchaser.

The highest or any other tender not necessarily accepted.

The other conditions of sale will be the standing conditions of sale of the Court, so far as applicable.

Further particulars as to the property, inventory and encumbrances may be had on application to the Liquidator or his solicitors.

DATED at Toronto, Canada, this 14th day of June, 1921.

OSLER WADE, Liquidator,
32, Front Street, W., Toronto, Canada.

McMASTER, MONTGOMERY, FLEURY & CO.,
901, Temple Bldg., Toronto, his solicitors. 5533

SITUATIONS OPEN (continued)

FOREMAN ENGINEER for General Machine and Fitting Shops REQUIRED for Ceylon works, engaged on full range of General Marine and Land Repair Work and the Manufacture of General Machinery. Only first-class regularly trained Turners and Machinists need apply. Must have some experience as Fitter on Repair Work and be capable of handling, directing and training native machinists and fitters on all classes of medium-heavy and light work.
Applicants must submit copies of references and certificates of technical night-school training, and be able to direct the marking-off of work from drawings, calculate weights of materials and fix operations and piece-work rates.
Agreement for three years; passage out, free quarters; monthly salary Rs. 500, 550, 600; leave on half pay if satisfactory.
Preferably the son of a man in business.
Address, 5874, The Engineer Office. 5874 A

FOREMAN BOILERMAKER REQUIRED for Ceylon; only first-class regularly trained men need apply; age 24-28, single; must be experienced in Boiler Construction and Boiler Repairs of all kinds; capable of directing permanent repairs to hulls of ships in dock, supervising and training native workmen, and taking charge of boiler, structural and blacksmiths' shop.
Applicants must submit copies of references and certificates of technical night-school training, and be able to direct the lay-out of work, calculate weights of materials and fix piece-work rates.
Agreement for three years; passage out, free quarters; monthly salary Rs. 500, 550, 650; leave on half pay if satisfactory.
Preferably, the son of a man in business, with knowledge of pneumatic tools, oxy-acetylene and electric welding.
Address, 5875, The Engineer Office. 5875 A

SITUATIONS WANTED

BUYER of WORKS SUPPLIES, Now Terminating important engagement, is DESIRING NEW APPOINTMENT; expert knowledge markets for materials, small tool, machinery. Keen organiser and departmental administrator.—Write, Z. X. 197, c/o Deacon's, Leadenhall-street, E.C. 3. 5797 B

CHARTERED PATENT AGENT, Trained Engineer (A.M.I. Mech. E.) and Mechanical Expert, is OPEN to ENGAGEMENT on the Staff of Engineering Works; long experience in the preparation and prosecution of patent applications in all countries and in the development of ideas and inventions.—Address, 5836, The Engineer Office. 5836 B

CIVIL ENGINEER, Assoc. M. Inst. C.E., DESIRES POSITION in Consulting Engineer's Office or as Contractor's Engineer; 7 years' experience as assistant engineer on public works; factory lay-out and construction; engagement at home, preferably in London; moderate salary if position progressive.—Address, P3782, The Engineer Office. P3782 B

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For continuation of Small Advertisements see page iii.

Improvements in Methods of Fatigue Testing.

By H. J. GOUGH, B.Sc.

THE following article is a report submitted in April of this year by Mr. H. J. Gough, of the Engineering Department of the National Physical Laboratory, to the Materials and Chemistry Committee of the Aeronautical Research Committee. Since the original paper was written Mr. Gough has extended the torsion fatigue test method described in the earlier portion to the testing of materials under reversals of bending stress. Particulars of the appliances used and the results obtained under this head are added at the end of the article. The paper will be published in due course in the Report of the Aeronautical Research Committee, but, believing that a method whereby the very valuable but tediously acquired results of a fatigue test can be obtained in a few minutes is a matter of general engineering interest which deserves wider publicity than it will obtain in this way, Sir Richard Glazebrook, the Chairman of the Committee, has, through Dr. Stanton, asked us to publish it in our columns in advance of the appearance of the report. With that request we have had great pleasure in complying.—ED. THE E.

Experiments on Alternating Torsion.—The machine used throughout these experiments was presented to the National Physical Laboratory by Mr. C. E. Stromeyer, after he had carried out a series of experiments which are fully described in the "Proceedings" of the Royal Society, 1914. Fig. 1—reproduced from Mr. Stromeyer's paper—illustrates the machine.

S c c S is the central crank shaft with a heavy flywheel F. It is driven by a direct-coupled electric motor—not shown. The throw, or double radius, of each crank is 1in. Two connecting-rods K K join the rotating cranks c c to the balanced rocking arms C C, whose radii are 4in. The shafts of the rocking arms end in clutches Q Q, and the spindles of the two oscillating masses W W have similar clutches into which the ends of the test pieces T T can be secured. The oscillating masses W W are built up of a number of circular discs, the polar moments of inertia of which are known.

For the purposes of the present tests it was found that the lubricating arrangements were unsuitable for prolonged runs, and further, that the fluctuations of speed when run by a motor supplied by the Laboratory mains were too great for any accurate determination of the stresses. Suitable devices were adopted in order to overcome these difficulties, with the result that the machine could be run day and night without attention, and a complete test on one material completed in little over a week.

Method of Calculating Stress in Specimen under Test.—The motion of the oscillating mass W was determined as follows:—A reed, carrying at its extremity a pen, was caused to vibrate in synchronism with a tuning fork of known frequency. A very stiff specimen was placed in the machine, which was run at a fixed speed. The vibrating reed was then drawn across a card attached to the oscillating mass. A series of dots obtained gave a time-displacement curve for the mass. On analysis this curve proved to be an extremely close approximation to simple harmonic motion.

If M = polar moment of inertia of mass W,
θ = angular amplitude of mass W,
I = second polar moment of section of specimen,
f_s = maximum shear stress in specimen,
n = speed of machine,
K = a constant,

then $f_s = \pm K M \theta n^2 / I$,

assuming a straight line stress distribution.

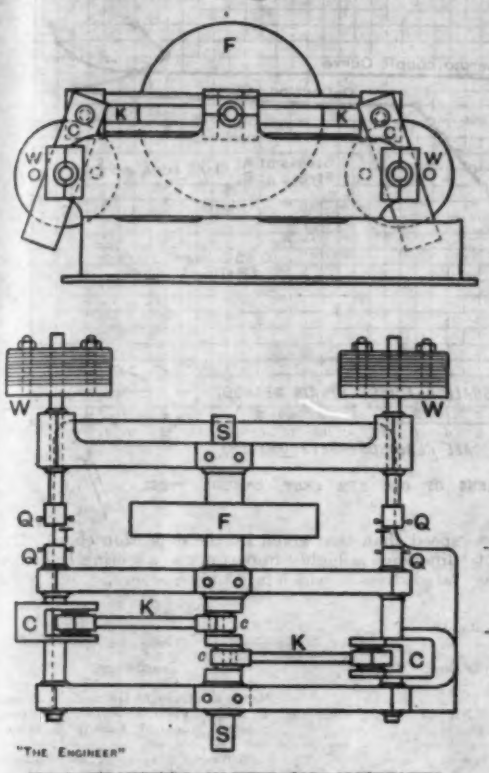


FIG. 1—STROMEYER'S MACHINE FOR ALTERNATING TORSION

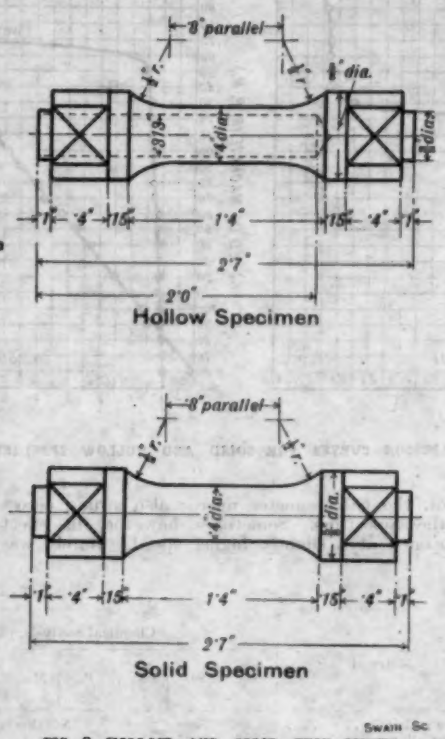


FIG. 2—HOLLOW AND SOLID TEST PIECES USED AT N.P.L.

Forms of Test Pieces.—The forms of test pieces, hollow and solid, used throughout the tests are shown in Fig. 2. It is well known that if endurance tests are carried out on solid and hollow specimens under reversals of bending stress by the Wöhler method, and the maximum stresses are plotted against number of reversals for failure, both curves ultimately become asymptotic to the same value of the limiting stress, but at widely different values of the reversals. The use of hollow specimens in fatigue tests by the Wöhler method has very much reduced the labour of predicting the limiting fatigue ranges. The same effect was found in the case of the present experiments, and for the prediction of the fatigue limit in torsion from endurance tests on the machine here described it has been assumed that the range of stress for fracture after three million reversals is a sufficient approximation to the fatigue limit of the material.

For the endurance tests the material used was a 0.65 per cent. carbon steel. The chemical composition and mechanical properties of this steel are included in Table II. and the results of the endurance tests in Table I. From the latter it will be seen that the limiting fatigue shear stress is about ± 10.5 tons per square inch. The fatigue limit for reversals of bending stress was also determined by the Wöhler method and found to be ± 21.0 tons per square inch. Assuming, therefore, that the fatigue limits are correctly predicted, these results would appear to confirm Guest's theory that elastic failure takes place for a certain value of the maximum shearing stress, since in the endurance test under reversals of bending the maximum shear stress was equal to the maximum shear stress in the torsional fatigue tests. These results are in agreement with the conclusions arrived at by Mason from tests on mild steel under reversals of shear stress—"Proceedings," Inst. Mech. Engrs., 1917). Before proceeding to an investigation of the torsional fatigue characteristics of other materials an attempt was made to shorten the work by the use of methods such as those of J. H. Smith* or C. E. Stromeyer.†

TABLE I.—*Endurance Tests on 0.65 per cent. Carbon Steel under Reversed Shear Stresses on a 3 Million Reversal Basis.*

Form of test piece.	Maximum shear stress, tons/inch².	Number of reversals.	Remarks.	Fatigue limit on a 3 × 10⁶ reversal basis
Solid	± 12.33	3,000,000	Unbroken	
,,	± 13.07	3,000,000	,,	
,,	± 13.37	3,000,000	,,	
,,	± 13.86	1,078,000	Broken	± 13.5 tons/inch²
,,	± 14.02	344,700	,,	
,,	± 14.80	260,000	,,	
,,	± 15.27	108,000	,,	
,,	± 15.80	59,900	,,	
,,	± 16.51	32,500	,,	
Hollow	± 9.43	3,000,000	Unbroken	
,,	± 9.58	3,000,000	,,	
,,	± 9.67	3,000,000	,,	
,,	± 10.10	3,000,000	,,	
,,	± 10.20	3,000,000	,,	
,,	± 10.40	3,000,000	,,	
,,	± 10.49	3,000,000	,,	± 10.5 tons/inch²
,,	± 10.50	360,000	Broken	
,,	± 10.70	364,000	,,	
,,	± 10.77	304,300	,,	
,,	± 10.9	1,375,000	,,	
,,	± 11.13	1,049,000	,,	
,,	± 11.33	565,000	,,	
,,	± 19.70	3,400	,,	

In Smith's method of testing materials under rapidly varying tensile stress a definite range of stress is imposed on the specimen by the use of unbalanced fly-wheels, the mean stress being then added by means of a spring. An optical extensometer was attached to the specimen throughout the test, and it was found that by gradually adding mean stress to a fixed range of stress a small but definite "yield" was ultimately observed at a stress which was in close agreement with the fatigue limit corresponding to the stress distribution obtained from endurance tests. In this way it was found possible to obtain sufficient data for the plotting of the Gerber parabola from tests lasting a few minutes each on a single specimen.

In Stromeyer's method the torsional fatigue limit is determined by measuring the stress at which a small but perceptible rise of temperature of the specimen due to internal work takes place. Water is passed slowly through a calorimeter surrounding the specimen, its temperature being measured at inlet and outlet. It is assumed that the torsional fatigue limit occurs at that stress at which the temperature of the outlet water rises by 0.02 deg. Cent.

After consideration of the methods adopted by previous experimenters, three methods of determining the torsional fatigue limit presented themselves for investigation, which consisted of—

(1) The rate of increase of strain with stress.

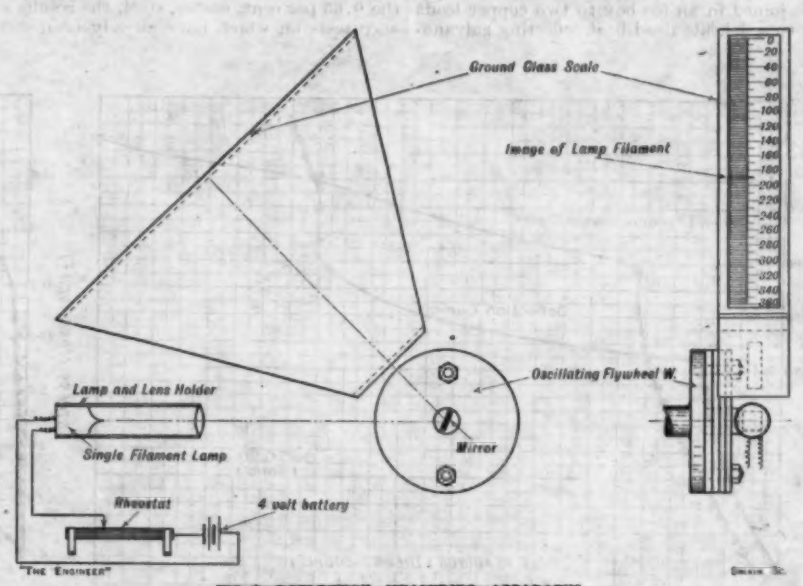


FIG. 3—DEFLECTION MEASURING APPARATUS

* *Journal* of the Iron and Steel Institute. No. II. 1910.
† Royal Society "Proceedings." 1914.

(2) The rate of increase of width of the hysteresis loop with stress.

(3) The rate of increase of temperature, due to internal work, with stress.

Method (3) is, of course, a calorimetric combination of methods (1) and (2). Methods (1) and (3) were decided upon, and to compare the relative values of these methods both methods were used simultaneously upon a number of specimens.

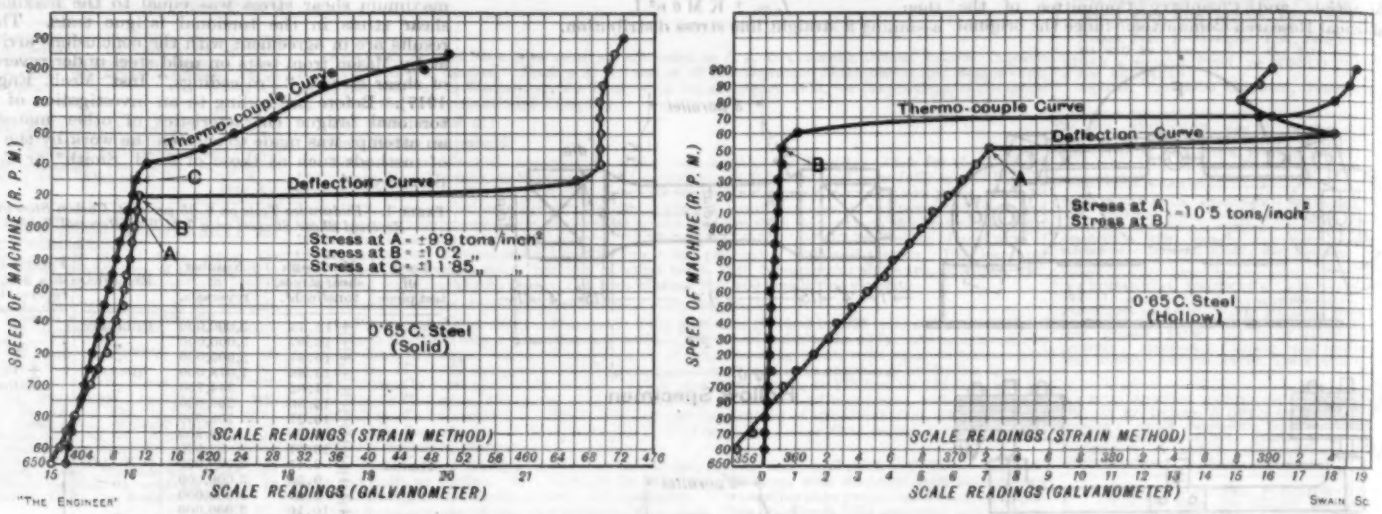
Apparatus.

Strain Measurements.—A simple optical method—see Fig. 3—was tried. A plane mirror was fitted to the end of the shaft of the oscillating mass W. The image of a single filament lamp was focussed, after reflection at the mirror, on to a graduated ground-glass scale contained in a cardboard box. As the mass oscillated the image moved up and down the scale. The usual speeds at which the machine was run varied from 350 to 1000 revolutions per minute. At these speeds, owing to the persistence of vision, the image appeared as a band of light, with very definite edges. There was practically no "flicker," and the scale could be read to an accuracy of ½ mm. The scale could be read clearly in daylight. The amplitude of the image does not represent the actual strain of the specimen under test, but the movement of the rocking shaft, together with the strain of the specimen. As, however, only the rate of increase of strain is required, this point is not material.

Thermal Measurements.—An iron Eureka couple was used, one wire being tightly wrapped round the centre of the specimen and soldered. A hole was drilled in one enlarged end of the specimen and the second wire soldered into it. The thermo-couple wires were joined in an ice box to two copper leads connected to a delicate dead-beat reflecting galvanometer, the image of a cross-hair and spot of light being focussed on a graduated ground glass scale.

Method of Test using Strain and Calorimetric Methods Simultaneously.—The specimen was placed in the holders and the machine run at a low speed. The speed of the machine was hand-controlled throughout all these tests. When the galvanometer reading had become steady, it and the strain scale reading were taken. The speed was then increased by increments of 10 revolutions per minute, both scales being read at each speed. At a certain speed, depending upon the material, the amplitude of the motion of the spot suddenly increased. In most cases, this increase was quite sudden and definite, the band of light opening out at both ends. In some cases, the galvanometer mirror also swung across at the same time. Sometimes, however, this effect happened at a slightly higher speed. Rarely was the "yield" point as clearly shown by the thermo-couple as by the strain scale.

Results.—The first material experimented on was the 0.65 per cent. carbon steel, the results of endurance tests on which have already been stated. Its chemical composition and tensile test results are given in Table II. Two specimens, one hollow and one solid, were used. The scale readings for both the thermo-couple and strain scale are plotted against speed of machine in Figs. 4 and 5. The very definite nature of the yields is shown clearly by the curves. The "yield" point occurred at stresses of ± 10.2 and ± 10.5 tons per square inch for the solid and hollow test pieces respectively. The difference may safely be ascribed to slight differences between the actual specimens tested. The thermo-couple curve for the hollow specimen indicates the same "yield" point as the strain or deflection curve. With the solid specimen, however, the thermo-couple curve gives the breakdown as occurring at a slightly higher speed than that given by the deflection curve. This difference is highly important as affecting the calculated stress at which breakdown occurs.



FIGS. 4 AND 5—THERMO-COUPLE AND DEFLECTION CURVES FOR SOLID AND HOLLOW SPECIMENS OF 0.65 PER CENT. CARBON STEEL

Table II.

Material	Chemical analysis, per cent. C.	Si.	S.	P.	Mn.	Ni.	Cr.	Al.	Mg.	Cu.	Tensile test. Stress at E. limit tons/in².	Stress at yield, tons/in².	Ultimate stress, tons/in².	Extension per cent. L/D = 3.6
Pure nickel	Not known										5.65	8.41	32.43	52
Light alloy	—	0.25	—	—	0.5	2.0	—	92.25	1.5	4.0	—	14.3	24.0	24
0.27 per cent. carbon steel	0.27	—	—	—	—	—	—	—	—	—	20.56	21.06	31.16	44.0
0.3 „ „ „	0.3	—	0.04	0.5	—	—	—	—	—	—	20.0	21.7	37.5	32
0.31 „ „ „	0.31	—	0.091	0.78	0.86	—	—	—	—	—	28.0	31.0	42.3	30.5
0.38 „ „ „	0.38	—	0.05	0.07	0.83	—	—	—	—	—	26.9	29.8	44.6	29
0.4 „ „ „	0.4	—	0.08	0.05	—	—	—	—	—	—	24.1	25.1	40.5	28
0.42 „ „ „	0.42	0.17	0.03	0.02	0.62	—	—	—	—	—	21.0	25.0	40.8	26
0.65 „ „ „	0.65	0.14	0.20	0.03	0.11	—	—	—	—	—	19.2	28.0	53.0	19.3
Boiler plate	0.25	0.06	0.03	0.05	0.65	—	—	—	—	—	11.5	15.5	29.2	34.5
Swedish iron	0.04	Trace	—	0.02	Trace	—	—	—	—	—	12.93	14.46	19.60	33.8
Armco iron	0.02	Trace	0.02	0.01	0.10	0.10	—	—	—	—	—	13.20	18.9	57.0

Note.—All the above materials, with the exception of the 0.65 per cent. carbon steel, were tested as received from the manufacturers without further heat treatment. The 0.65 per cent. carbon steel was normalised at 800 deg. Cent.

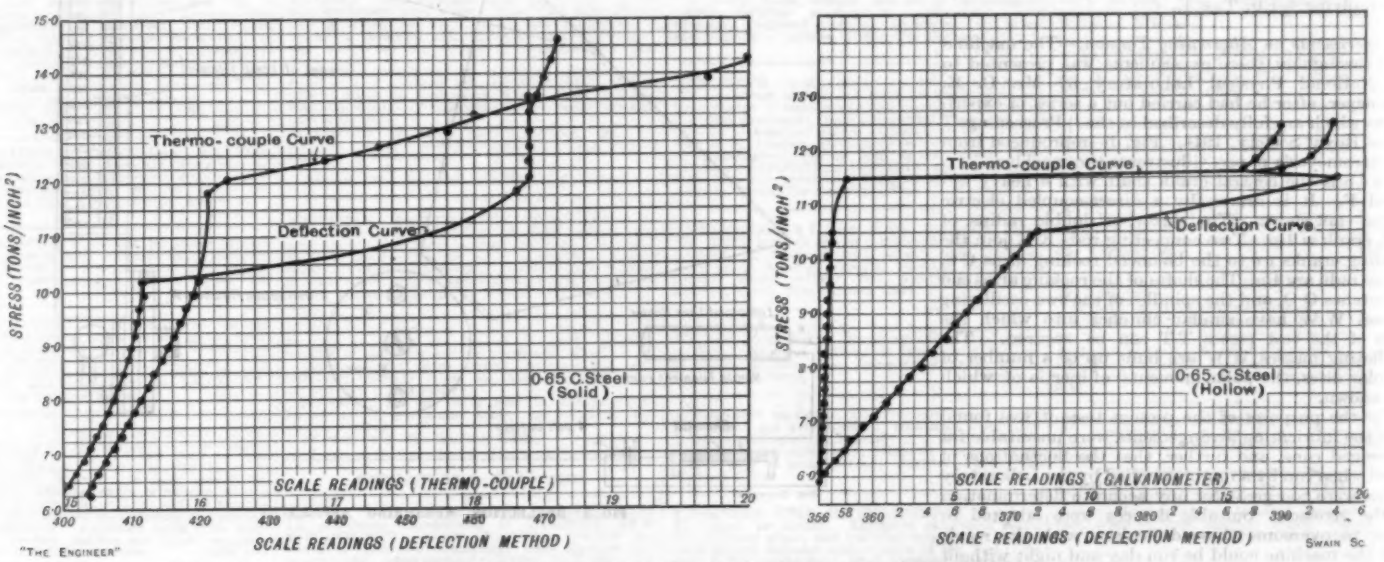
Reference to the formula from which the stress is calculated—

$$f_s = \pm K M \theta n^2 / I,$$

shows that the stress is proportional to the amplitude of the oscillating mass. In Fig. 4 the calculated stresses at the points A, B and C are as follows :—

Stress at A = ± 9.9 tons per square inch.
„ B = ± 10.2 „ „
„ C = ± 11.85 „ „

Considerable error is involved if the yield point were assumed to be (from the thermo-couple curve) at C instead of at B (from the strain curve). In



FIGS. 6 AND 7—CURVES OF FIGS. 4 AND 5 RE-PLOTTED TO STRESS ORDINATES

several other tests a similar "lag" was noted on the thermo-couple curve.

To show this point more clearly, Figs. 4 and 5 have been re-plotted to "stress" ordinates—see Figs. 6 and 7. That the fatigue limit is masked by the thermo-couple in the case of the solid specimen may have been due to the following causes:—(1) The galvanometer used may not have been sufficiently sensitive; (2) owing to the larger heat capacity of the solid specimen, the lag of the thermo-couple may be a time effect. In some further experiments now being carried out, a galvanometer of much greater sensitiveness is being employed. Also a longer time interval is allowed before the galvanometer is read.

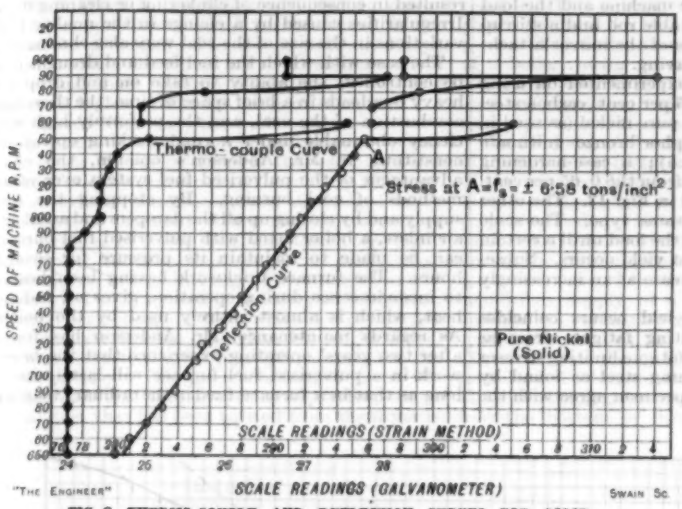


FIG. 8—THERMO-COUPLE AND DEFLECTION CURVES FOR SOLID SPECIMEN OF PURE NICKEL

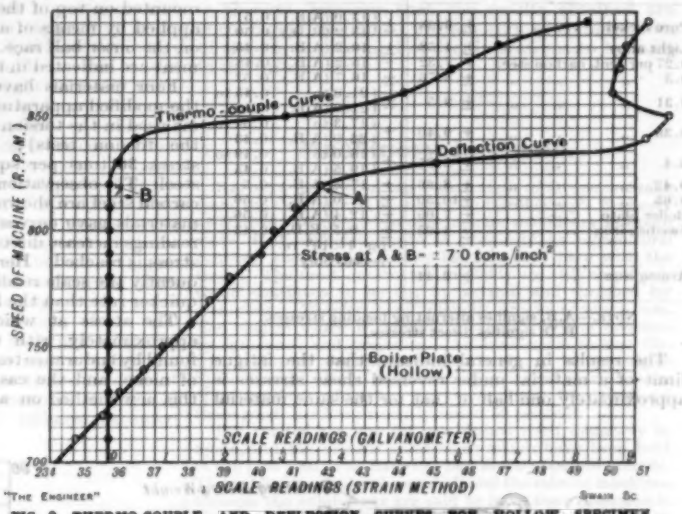


FIG. 9—THERMO-COUPLE AND DEFLECTION CURVES FOR HOLLOW SPECIMEN OF BOILER PLATE MATERIAL

From these tests on 0.65 per cent. carbon steel, the following conclusions were drawn:—(1) That the fatigue limit under reversed shear stresses is marked by a "breakdown" or "yield" point in the material, as in Smith's experiments with direct stresses; (2) That this breakdown point is independent of the form of the section, solid or hollow; (3) that Guest's law applies to fatigue stresses. It can be seen that thermo-couple curve. Three observers are necessary for a calorimetric determination, whereas only two are required for the strain method. These facts lead to the conclusion that the strain method is more accurate and practical, although the calorimetric method is useful as a check.

With these precautions the thermo-couple indicates the fatigue range at a stress in agreement with that given by the yield method. The change of slope of the stress temperature curve is, however, nearly always less than that of the stress strain curve. This fact would lead to the inference that if the calorimetric method of determining fatigue limits were used in a machine in which the stress applied was independent of the strain—the usual type of testing machine—it would be extremely difficult to estimate the stress at which the slope of the stress temperature curve changed. Some experiments recently carried out at the National Physical Laboratory with a "Haigh" machine confirm this inference. With these results and conclusions confirm those obtained by Dr. J. H. Smith for alternating direct stresses.

To prove that these deductions can be generally applied, it is necessary to carry out, on a large number of materials, the following tests:—(*a*) Endurance tests under reversed torsional stress using hollow and solid specimens; (*b*) determination of torsional fatigue limit by the strain method described above; (*c*) endurance tests under reversed bending or direct stresses. Before embarking on a lengthy series of endurance tests, it was decided to compare the torsional fatigue limits with the direct stress fatigue limits of as many materials as were immediately available. Table II. shows a list of these materials, eleven in number, with their chemical composition (where known) and tensile test results. The strain readings and thermo-couple readings (where taken) for some of the materials are shown plotted in Figs. 8 to 11 inclusive.

Remarks on Curves.—A curious phenomenon was observed in the case of nickel, Fig. 8. The material definitely yielded and recovered. At a slightly higher stress it again yielded and again recovered. This is the only material which has, so far, behaved in this way.

The following materials gave curves similar to that of the boiler plate material reproduced in Fig. 9:—Rolled piston light alloy, 0.27 per cent. carbon steel, 0.3 per cent. carbon steel, 0.31 per cent. carbon steel, 0.38 per cent. carbon steel, 0.4 per cent. carbon steel, 0.42 per cent. carbon steel.

In all these cases the strains steadily increased with the speed until a certain speed was reached when breakdown occurred, the increase of strain becoming very rapid. The curves obtained with 0.65 per cent. carbon steel have already been commented on.

Fig. 10 shows the results of the test on Swedish iron. The material was apparently very unstable up to a certain speed (500 revolutions per minute). For the next two increments of speeds the strains increased regularly, followed by a definite yield. Subsequently the strains again increased in a regular manner. This result was so unexpected that a second specimen of the same material was prepared. The mass of the oscillating weight was reduced so that the breakdown would occur at a higher speed. The curve obtained was very similar to the first. Whether the peculiar shape of the first part of the curve is due to a change in the modulus of rigidity as the stress increases, it is as yet impossible to say.

The results of the test on Armco iron are plotted in Fig. 11. The curve obtained is of a similar nature to that for Swedish iron, although the yield is not so definite. A second test gave an identical result. It is, of course, futile to attempt to draw large conclusions from these four tests, but it appears to be probable that these soft irons are unstable under reversed shear stresses until after the stress producing breakdown has been passed.

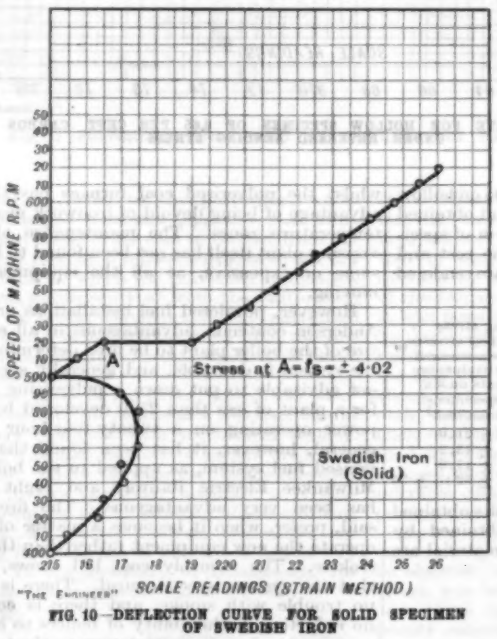


FIG. 10—DEFLECTION CURVE FOR SOLID SPECIMEN OF SWEDISH IRON

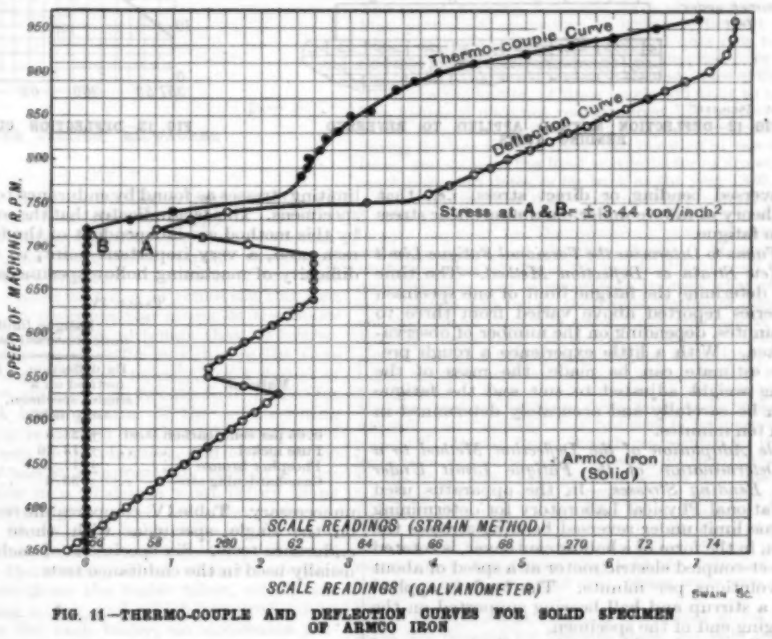


FIG. 11—THERMO-COUPLE AND DEFLECTION CURVES FOR SOLID SPECIMEN OF ARMCO IRON

There is no doubt that the success of the yield and calorimetric methods described in this paper are due to the state of instability of the specimen under test, owing to the character of the machine employed. Directly a yield in the specimen occurs, the stress is automatically increased, producing a greater yield, and this multiplying effect continues until a second state of equilibrium or partial stability occurs. Careful deflection readings must obviously be taken in order to calculate the fatigue limit as shown by the

Comparison of Torsional Fatigue Limiting Stress Found by Yield Method with Direct Stress Fatigue Limit as Determined by Endurance Tests Using other Machines.—Column A, Table III., gives the fatgue limit under reversed shear stress as found by the "yield" method. Column B gives the fatigue limit under reversed bending or direct stresses for the same materials as determined by endurance tests. Column C expresses these results as a ratio. It will be seen that the 0.38 and 0.4 per cent. carbon steels had given irregular results during the endurance tests under

reversed bending fatigue. The value of ± 9.5 tons per square inch for the fatigue limit for reversed direct stress for Swedish iron was the value obtained for one million reversals only. The true fatigue limit for unlimited reversals would undoubtedly be lower than this value and more nearly approach the value of twice 4.05 tons per square inch (the torsional fatigue limit).

TABLE III.

Material.	Col. A. Torsional fatigue limit (yield method) shear stress tons/inch².	Col. B. Fatigue limit under reversed bending or direct stresses (endurance tests) tons/inch².	Col. C. Ratio of A/B.
Pure nickel	± 6.58	± 13.0 (A.B.) / 13.2 (R.D.)	0.51 / 0.50
Light alloy	± 4.58	± 10.2 (A.B.)	0.45
0.27 per cent. carbon steel	± 7.32	± 15.2 (A.B.)	0.48
0.3 " " "	± 8.76	± 16.7 (A.B.)	0.52
0.31 " " "	± 9.5	± 21.0 to 22.0 (A.B.)	0.45 to 0.43
0.38 " " "	± 9.40	± 17.3 to 22.0 (A.B.)	0.54 to 0.43
0.4 " " "	± 8.85	± 18.0 to 19.5 (A.B.)	0.49 to 0.45
0.42 " " "	± 8.66	± 17.3 (A.B.)	0.5
0.65 " " "	± 10.50	± 21.0 (A.B.)	0.50
Boiler plate	± 7.00	± 12.4 (A.B.)	0.56
Swedish iron	± 4.05	± 9.5 (R.D.) for 1×10^6 reversals only	0.43
Armco iron	± 3.44	—	—

NOTE.—A.B. signifies alternating bending stresses. R.D. signifies direct stresses.

The results in general indicate that the fatigue limit of a material under reversed shear stresses is approximately one-half of that for the same material under reversed bending or direct stress, *i.e.*, that Guest's theory of failure under maximum shear stress applies to fatigue.

Time Taken to Determine the Torsional Fatigue Limit by the New Strain or Deflection Method.—The time taken to determine the fatigue limit of one specimen of the series reported above varied from three to fifteen minutes, depending on the number of observations taken. With a little experience a rough preliminary estimate can be made, the mass of the oscillating weight adjusted to suit and the fatigue limit can be carefully and accurately determined in less than ten minutes.

Possible Adaptation of the Deflection Method to a Quick Determination of the Fatigue Limit Under Reversed Bending Stresses.—In the apparatus used at the National Physical Laboratory for determining the fatigue limit under reversed bending stresses the specimen, in the form of a hollow cantilever, is rotated by a direct-coupled electric motor at a speed of about 2200 revolutions per minute. The load is applied through a stirrup and ball bearing supported on the overhanging end of the specimen.

The following possible quick method suggested itself for determining the fatigue limit. If the load were increased by increments and the deflection of the end of the cantilever observed, then a deflection-load diagram would probably indicate a "breakdown" point at the fatigue limit. Owing to the fact that the maximum stress occurs only at one section, the "breakdown" would probably be visible as an "elastic limit" effect rather than as a "yield" effect as in torsion.

A plane mirror was affixed to the non-rotating ball cage and the deflection magnified optically. At each load the image of the filament on the scale was read. It was necessary, owing to the weights employed, to remove the load altogether at four points, with the result that the ball cage fell slightly. The curve at these points was consequently discontinuous, but for the specimen used, the 0.65 per cent. carbon steel (as used in the torsion experiments), a departure from the straight line law was clearly indicated at a point corresponding to a stress of ± 20.74 tons per square inch. The endurance tests, it will be recalled, had given the fatigue limiting stress as ± 21.0 tons per square inch.

The experiment seemed to indicate that the method would prove an extremely quick and reliable one for determining the fatigue limit under reversed bending stresses. The apparatus was accordingly modified so that the load could be applied continuously. The mirror was mounted on the specimen and allowed to rotate with it. Fig. 12 shows the new arrangement. A 150 lb. capacity single lever weighing machine was mounted on top of the Wöhler machine and the load applied by means of an adjustable rod and a stirrup on the outer ball race. Details of the mirror attachment are indicated in the engraving.

Four materials have been experimented on using the modified apparatus:—0.65 per cent. carbon steel (as used in the torsion tests); pure nickel (as used in the torsion tests); a phosphor-bronze (ultimate stress 36 tons per square inch); a case-hardening steel. The observations taken from the 0.65 per cent. carbon steel are shown plotted in Fig. 13. The other materials gave curves of the same type. The scale readings increase directly with the load until a certain stress is reached. Here a slight yield occurs. Subsequently the scale readings increase at an increasingly quicker rate than the load.

The stress at which the yield occurs coincides approximately with the limiting fatigue stress as found by endurance tests. The fatigue limiting stresses of nickel and the case-hardening steel as found by this new method on a solid specimen agree with the limiting stresses as found by endurance tests on hollow specimens. This fact indicates that the result obtained by this method are independent of the form of specimen used, a very important point, as the cost and difficulty of machining hollow specimens are rendered unnecessary. Table IV. compares the results obtained on the single specimens with those obtained by endurance tests. Six specimens of each material are usually used in the endurance tests.

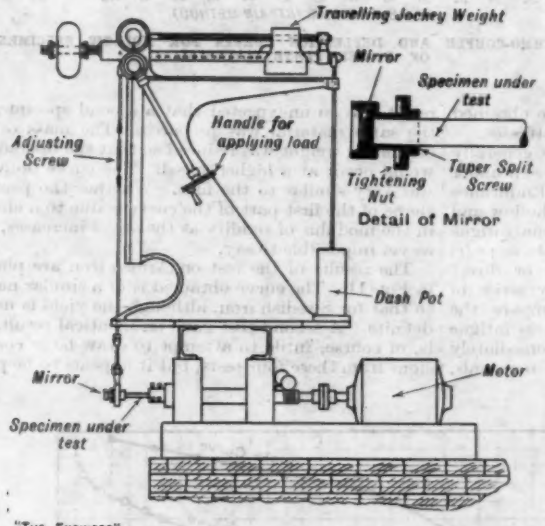


FIG. 12—DEFLECTION METHOD APPLIED TO REVERSED BENDING TESTS

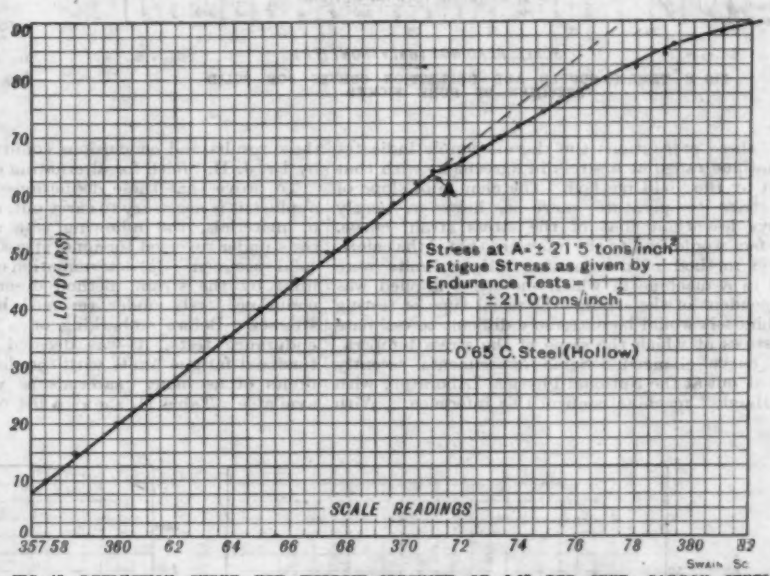


FIG. 13—DEFLECTION CURVE FOR HOLLOW SPECIMEN OF 0.65 PER CENT. CARBON STEEL UNDER REVERSED BENDING STRESS

TABLE IV.

Material.	Fatigue limiting stress under reversed bending stresses. By deflection method on a single specimen, tons/inch².	By endurance tests on six specimens, tons/inch².
0.65 per cent. carbon steel	± 21.5	± 21.0
Pure nickel	± 13.26	± 13.2
Phosphor bronze	± 17.2	± 17.8
Case-hardening steel	± 33.6	± 32 to ± 35

Developments in Power Station Design.

No. IV.*

FROM time to time much has been published in America on the results that have been secured with pulverised coal. Not long ago, for instance, Mr. John Anderson, chief engineer to the power plants of the Milwaukee Electric Railway and Light Company, gave some interesting facts concerning his experiences in a paper read before the Technical League of the Employers' Mutual Benefit Association at Milwaukee. In discussions on furnace efficiencies, Mr. Anderson explained, consideration should be given to the adaptability of a pulverised fuel-fired furnace to the use of widely varying grades of coal without resultant loss in economy. Boiler capacity, even at times of heavy overloads, was, he stated, in no way affected when an inferior quality of coal was burnt. With pulverised fuel, the combined efficiency of a boiler and furnace did not, he said, decrease when the fuel was poor. When equipped with proper instruments, the operation of a pulverised fuel plant could be varied to enable the boilers to deal with big fluctuations of load over very brief periods. A heavy overload could be quickly taken over or dropped off by the adjustment of the coal and air feeds, and without any waste of coal. No losses resulted in consequence of clinkering or cleaning fires. Irregularities caused by a change in the quality and variations in the size of the coal were also eliminated.

The ease with which the fuel feed and draught can be controlled, the ability to take on and drop off heavy overloads in a brief space of time, the thorough combustion of the coal, and the uniformly high efficiency obtainable under normal working operation, constitute, in Mr. Anderson's opinion, the chief advantages of the pulverised fuel system over other methods of coal burning. By stopping the fuel supply and by closing up all the dampers and auxiliary air inlets, a boiler fitted with pulverised fuel burners can be made to maintain its pressure for several hours. The furnace brickwork having been heated to incandescence during operation, gives off radiant heat, which is almost entirely used by the boiler. As regards maintenance, Mr. Anderson has found after two years' operating experience that the brickwork in a pulverised fuel furnace will last quite as long as that in a furnace fired in the ordinary manner, whilst the pulverised coal furnace has the further advantage of being devoid of ironwork near the high temperature zones. The maintenance of the pulverising plant itself has not been found to be troublesome or expensive, as all the equipment is slow moving.

However, powdered fuel installations are not, Mr. Anderson contends, advantageous in all cases. The size of the boiler plant to be fired determines whether the system is desirable, and, generally speaking, it is not advisable to put down a pulverising equipment for a plant of less than 2500 developed boiler horsepower operating on a twenty-four-hour basis. In general, however, it has been found that the pulverised fuel system, as applied to the boilers of the Milwaukee Electric Railway and Light Company, has been very advantageous. The firemen, it is said, prefer, when it becomes a matter of choice, to operate the new equipment rather than the ordinary stokers. The monthly coal bill shows, moreover, that the system is economical. There is absolutely no trouble with smoke, and there is consequently no reduction in the ability of boilers to absorb heat on account of soot accumulating on the tubes. High sulphur coal, which in the ordinary way is destructive to boiler tubes, chimneys, and all the other steel equipment associated with boiler installations, can, it is said, be burnt in a much more satisfactory manner when pulverised, as the low moisture content of the coal, as fired, reduces the opportunity for the sulphuric acid to attack the metal.

Although much has been said about the liability of explosions, Mr. Anderson has not experienced any such unpleasant occurrences. Explosions can be entirely avoided, he explains, by preventing the coal being dried too much and being ground to a fineness beyond that which is necessary. It is considered that an engineer who is careful with his ordinary steam and electrical plant can operate a pulverised fuel

* No. III. appeared August 5th.

plant successfully with no assistance beyond his own experience. Complete combustion with the least amount of excess air demands the best distribution of the air, and the problem of furnace efficiency resolves itself mainly into one of air supply, not only to the furnace alone, but to each particle of coal. With fuel finely pulverised, air can be made available to each particle, since the surface exposed to the air is increased many times that of the same weight of coal when in lump form, and combustion is rapid, complete and efficient. With fuel in lump form, air must be supplied through a bed. The outer surface of the lumps must be burnt off, the process of combustion eating into the fuel slowly, and as a result combustion is often gradual and unequal, for where the fire is thin too much air is passed, whilst where it is thick there is insufficient air, and to ensure complete combustion in any furnace some excess air must be provided. The use of pulverised coal, however, reduces the excess air to a minimum, gives a higher and more uniform percentage of CO_2, and therefore a higher and more uniform efficiency.

The sketch Fig. 11 shows the pulverised fuel-burning plant installed in the Oneida-street power station of the Milwaukee Electric Railway and Light Company. Coal is delivered to the station by barge. It is run over an automatic scale, discharged on to short conveyor provided with a magnetic separator for the removal of tramp iron, and then passed into a Peck carrier, which carries it to the raw coal storage bunkers shown in the drawing. From these bunkers it is conveyed and elevated to a Jeffrey disintegrator, in which it is crushed, and from which it is discharged into a small storage bin, and then fed to the dryer, which is constructed on the principle described in the previous article. The gases discharged from the dryer are delivered into a cyclone separator, where any coal dust that has been carried from the dryer is

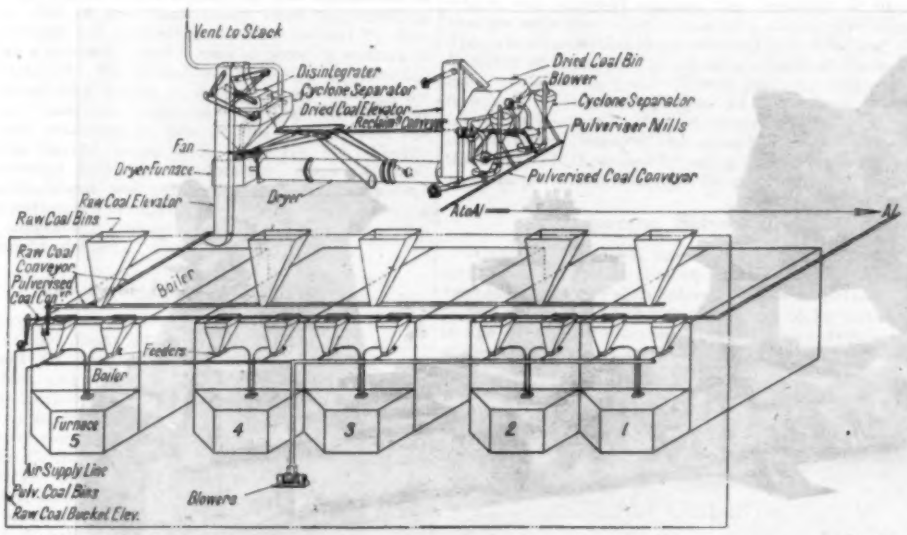


FIG. 11—PULVERISED FUEL PLANT AT ONEIDA-STREET POWER STATION, MILWAUKEE

reclaimed and conveyed to the pulveriser, whilst the gases discharged from the separator pass away into a chimney. The dried coal is carried from the dryer discharge pipe by a bucket elevator to the dry coal storage bins, to which the pulveriser feeders are connected, and pulverised coal from the mill outlets is conveyed by screw conveyors to the pulverised fuel storage bins. Screw feeders then take the fuel to the air-mixing chamber, from which it is blown into the furnaces.

Mr. Anderson gives in his paper, which was mentioned at the outset, full details of a test carried out on five boilers equipped with mechanical stokers, and a test on a similar number of boilers fired with pulverised coal. Whilst the difference in the efficiency is not great in this particular instance, it is considered that, owing to the elimination of losses arising from banking, &c., under practical conditions, the saving arising from the use of pulverised fuel is very appreciable. In the summary of conclusions, the efficiency in the two cases is set out as follows :—

	Pulverised fuel system.	Modern stokers.
Actual gross efficiency, per cent...	80.67	76.8
Net efficiency, after all incidental losses have been accounted for	72.32	70.88
Difference in favour of pulverised fuel system, per cent.	1.44	—

Mr. Paul W. Thompson, technical engineer to the power plants of the Detroit Edison Company, was present throughout the four days of the test, and has published an interesting account of his impressions. The boiler operation, with pulverised fuel, was, Mr. Thompson explains, much simpler than with the usual methods. The rate of steaming was controlled by the speed of the feeder motors and by adjusting the dampers to suit the different quantities of flue gas. It is unnecessary to look into the furnace at frequent intervals ; in fact, when once the feeder speed has been set to give a certain rate of steaming there is no need to make any further adjustment. Variations in the kind of fuel burnt seem to have no effect upon the operation, except that when the fuel feed is maintained constant the rating of the boiler varies with the heating value of the coal. At one time during the test Youghiogheny fuel was used, and it had a higher heating value, higher volatile content, less ash and less sulphur than the mixture of Youghiogheny and Kentucky coal which was used throughout the remainder of the test.

Troubles, such as those arising from the breakdown of mechanical stokers, loosening and breaking up clinkers, are eliminated. Efficient combustion is obtained at all times without continual supervision by an experienced operator, and the plant is perfectly reliable. This is an item of great importance with plants designed for 4.5 kilowatts capacity or more per installed boiler horse-power, in which the failure of a boiler, owing to stoker trouble at the time of maximum load on the station, might seriously overload the remaining boilers or make it necessary to drop a portion of the load on the plant.

The handling of the ash resulting from combustion of the pulverised fuel is a very simple matter, because of the very small quantity which is deposited in the furnace. The ash is in the form of a very fine impalpable powder, which during the test was removed twice every twenty-four hours. On several occasions during the first and second day of the test, slagging occurred in one of the furnaces in consequence of an insufficient supply of air, the trouble being attributable to over-anxiousness on the part of the men conducting the test to obtain a high percentage of CO_2 in the flue gas. A reduction in the excess air permitted the furnace temperature to rise to a point at which slagging occurred. The removal of this slag from the bottom or floor of the furnace presented more difficulty than is usually experienced in removing the refuse from the ash hopper of a stoker-fired boiler. It appeared, however, that this formation of slag could have been almost completely avoided by a more frequent inspection of the floor of the furnace. Even at times of removing the slag it was possible to maintain the rating of the boiler by increasing the coal feed, although that, of course, resulted in decreasing the efficiency during the time the slag was being removed, namely, for a period of about forty-five minutes in twenty-four hours for each boiler. A large portion of the ash resulting from combustion is carried on through the flues of the boilers and out of the chimney, and owing to the fineness of this ash it is apparently carried a considerable distance in a moderate wind before being precipitated. Throughout the test there was a moderate wind blowing, probably between four and eight miles per hour, and no noticeable deposit could be observed in the streets. Even when the deposit of ash was blown from the boiler tubes, which was done three times a day and which required about twenty minutes for each boiler, no noticeable precipitation of ash could be found. At no time during the test was there any tendency for slag to form on the tubes of the boiler.

The Milwaukee Electric Railway and Light Company has found that it is possible to hold a boiler up to pressure for about ten hours by the radiant heat stored up in the furnace and boiler seating. The loss which occurs, and which can be compared with the banking loss in a stoker-fired boiler, is represented by the heat which is radiated from the boiler and seating, and is equivalent in amount to that required to heat the boiler and seating again to the temperature attained when steaming. Where the ratio of boiler hours to boiler steaming hours averages 43 per cent. or more, which corresponds to an average daily plant load factor of 67 per cent., the saving resulting from the use of pulverised coal is well worth considering.

Mr. Thompson is not of opinion that under test conditions over a period of constant boiler rating, the efficiency obtained with pulverised fuel will exceed that which has been secured with the best mechanical stokers under similar operating conditions, but it is believed that the elimination of the many variable conditions entering into stoker operation will result in a higher efficiency for the pulverised fuel installation. The gross overall efficiency of boiler and furnace obtained from the test would, it is considered, have been higher had the boiler been cleaned prior to the tests. As a matter of fact, each boiler had been in operation before the test approximately 600 hours since being entirely cleaned. It is thought, however, that the results obtained are encouraging enough to warrant serious consideration of the use of this kind of fuel in stations to be built in the future.

Machinery in Spain.

Reports received in the Department of Overseas Trade from the Commercial Secretary to his Majesty's Embassy at Madrid with regard to openings for machinery in Spain state, that although Spain is primarily an agricultural country, the Spanish farmer has not kept pace with the times. The most antiquated methods are still employed. Grain continues to be cut by scythes and threshed by trampling. Wooden hand ploughs are in common use. The change which is inevitably taking place is retarded by ignorance and prejudice. An innovation in one district is slow to react in the next. In short, the opening in Spain for agricultural machinery is wide, but new business often involves educating the buyer first. The tariff on these goods has been recently raised 50 per cent.

The tractor has not yet established itself definitely in Spain, and the various exhibitions which have been held in the past year or so have not had much apparent success. The public interest has been small and the sales of machines through the exhibitions are said to have been disappointing. The chief advantage of these shows seems to lie in the extensive Press notice they have received. The market for tractors is more of the future than the immediate present, though the time is opportune for manufacturers to lay the foundations of business by making their machines known.

Winnowing and cleaning machinery is made in Spain, though there is certainly a margin for popularising the use of modern machines of which, it is suggested, the British manufacturers might take advantage if able to compete in price. Milling machinery is partly imported and partly manufactured in the country. The demand for wine and cider presses is largely supplied by local production, but there seems to be an opening in the Vigo district. Drilling and threshing machines are not much used. On the other hand, there is a growing foreign trade in small motors for agricultural use. In this the Swiss and Germans are keen competitors.

The trade in non-agricultural machinery other than that used for mining should have received a stimulus from the recent increase in the import duties on manufactured goods, though the duties on machinery have also been increased. The metal working industries have obtained a specially high protection amounting to between 100 and 250 per cent. As regards screws and screwed nuts it is true that hitherto the demand has been mostly supplied from abroad, and it is to be expected that with the assistance of the duties the home production of these goods will tend to increase. The Spaniard does not readily renew his machinery, and in the Barcelona district hardly any of the profits made during the war seem to have been invested in new installations, and some of the local textile factories are still using machinery that dates as far back as the year 1880.

The following local trade openings have been reported :—In the Barcelona district water turbines are likely to be largely required for the numerous power plants which are being put up all over the country. At present this trade is almost wholly in the hands of Swiss and German manufacturers, but it remains to be seen what effect on this demand will follow the Royal Decree of June 14th, obliging future holders of water power concessions to use Spanish machinery whenever possible. Centrifugal pumps are also largely required for irrigation purposes. Light cheap pumps and motors are at present supplied by American, German, Norwegian, and Swiss makers. Machine tools on a large scale have been supplied by America and Germany, but business is temporarily at a standstill. British firms, though represented on the spot, have been unable to compete owing to their high prices. In the Vigo and Corunna areas screws and files are in large demand. The Spanish product is of very poor quality. In this connection the British Vice-Consul at Corunna gives a striking illustration of the insidiousness of German methods. When Germans quote prices of their goods to merchants in his district they add the following clause, "If these prices are found dear, please make us a counter offer."

The Vice-Consul at Castellon states that in his district there is a demand for machine tools, not only for metal workers, but also for woodworkers. In the carpentering and cabinetmaking industries much work is done by hand which could with advantage be done by machinery. The manufacture of all sorts of house furniture has developed considerably of late years and a large export trade has been established. But in order to introduce the machinery manufacturers must either send travellers who are able to explain the advantages of their machines, or they must appoint agents with security of their appointment for a number of years ; it is not likely, it is stated, that propaganda confined to the sending of catalogues will lead to business.

One of the additions made to the Railways Bill is the requirement that the Rates Tribunal shall annually make a report to the Minister of Transport of its proceedings.

MACHINE TOOLS AT WELL HOUSE FOUNDRY, LEEDS

(*For description see page* 166)

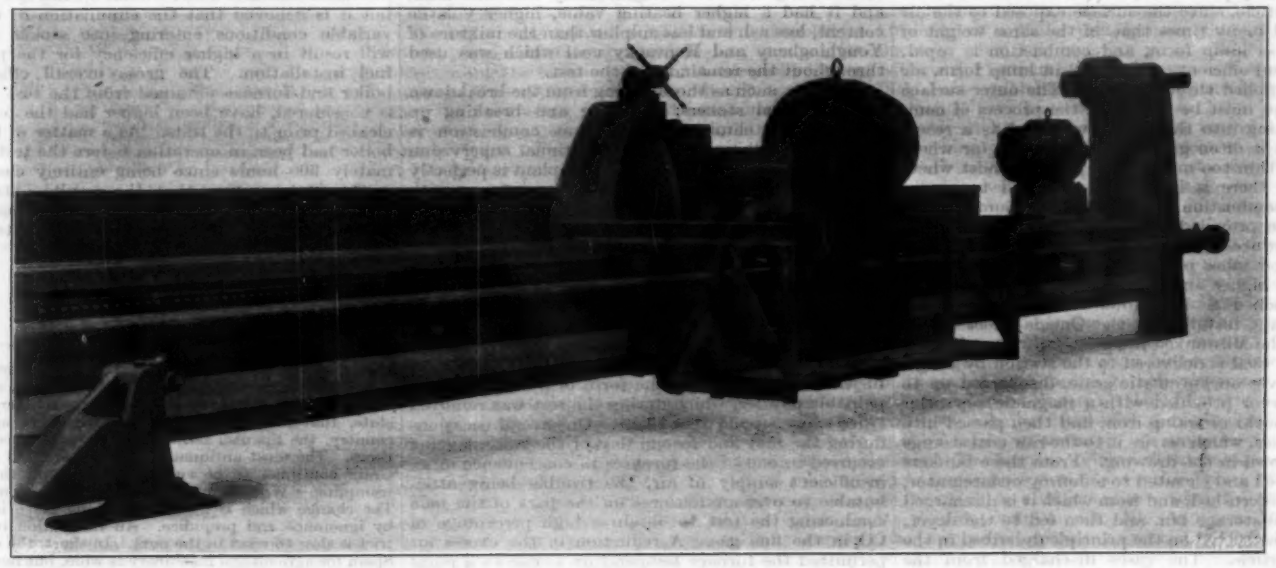


FIG. 1—40 FT. PLATE EDGE PLANER WITH RACK DRIVE

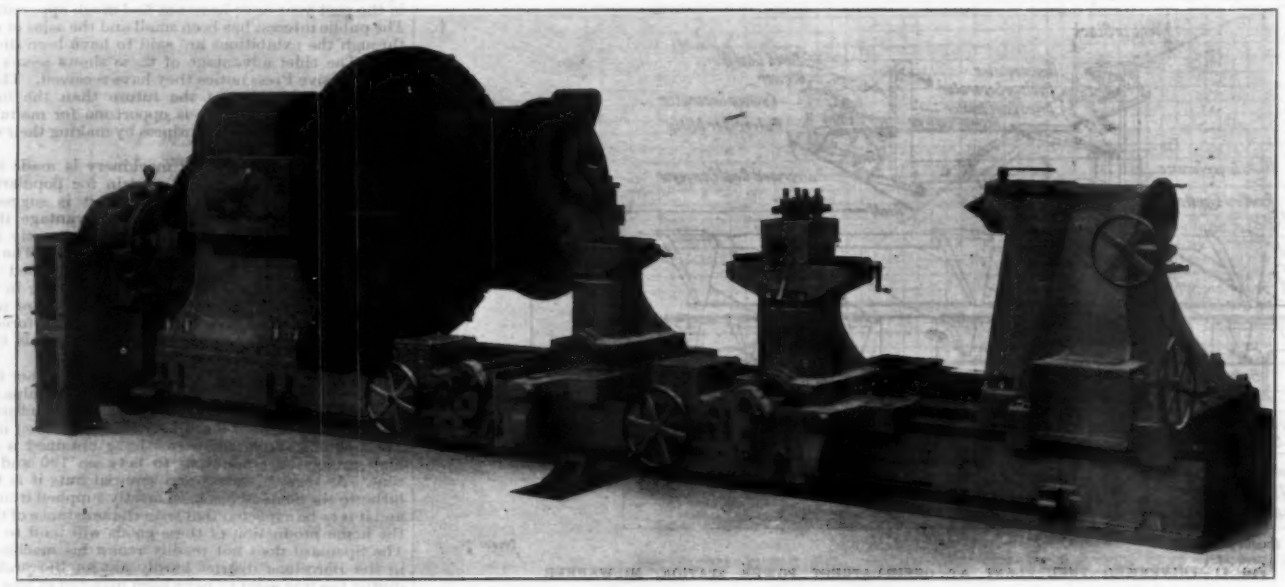


FIG. 2—50 INCH HEAVY LATHE

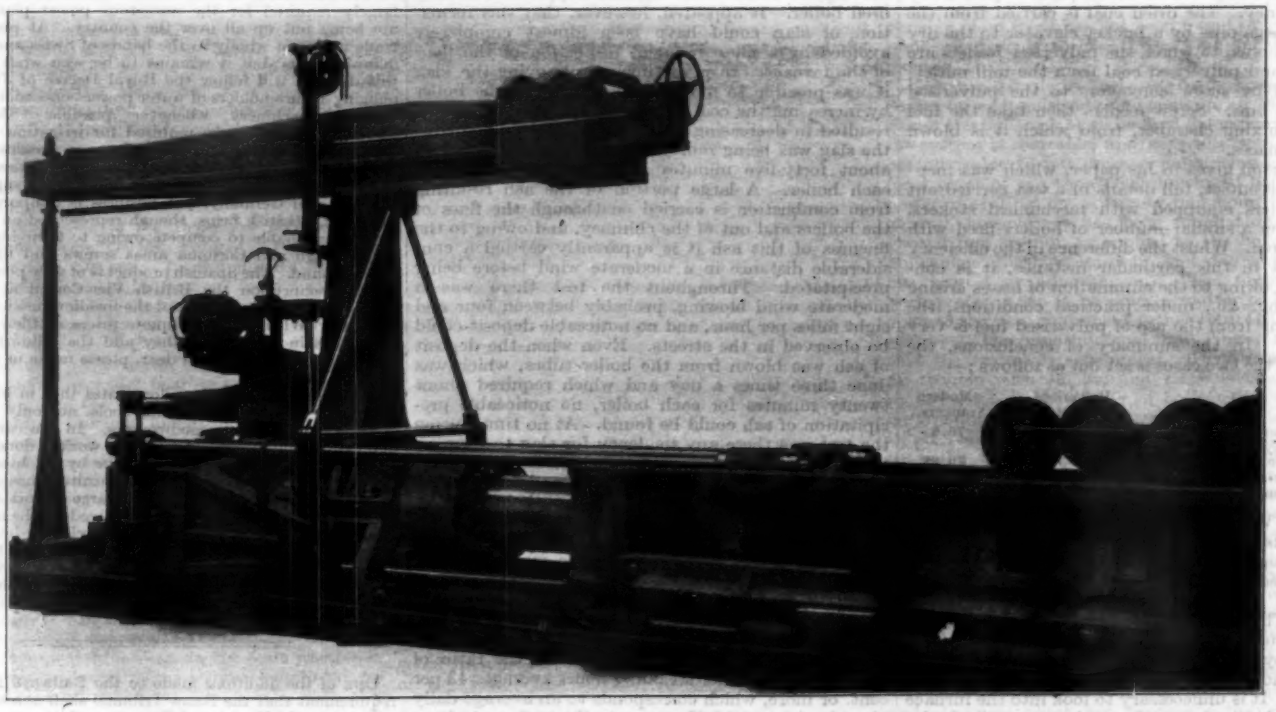


FIG. 3—400-TON CHAIN CABLE AND ANCHOR TESTING MACHINE

A Seven-Day Journal.

New Battle-Cruisers.

It is generally assumed in shipbuilding circles that the firms with whom orders which were afterwards cancelled for constructing the sister ships to the Hood were placed will, with the builders of that vessel, be selected to tender for the new battle-cruisers to which class, after a good deal of discussion whether the Hood should be regarded as a battleship or battle-cruiser, the new ships will belong. The four Hoods were laid down, one at the Clydebank yard of John Brown and Co., who completed the name ship of the class, at Armstrong Whitworth's naval yard, where the Anson was under construction, at Cammell Laird's, who had the Howe in hand, and at the Fairfield yard, where the Rodney was being built. There are other firms, the names of which need not be mentioned here, which would obviously have the right to tender for vessels of this class, and their names will probably be added to the list.

Safeguarding of Industries Bill.

The attempt made in the House of Commons on Wednesday to exclude from the operation of this much-discussed Bill material imported for the purpose of being used in shipbuilding or ship repairing failed. The main argument of those who desire to avoid the semblance of protection for shipbuilding steel or other materials used in the shipyard is that the home steel industry, which would benefit by the imposition of duties, was of less importance than shipbuilding, which ought not, moreover, to be penalised by dear steel at a moment when it was engaged in a struggle for existence. To extend the provisions of the Bill to shipbuilding would, it was asserted, deal a blow at our maritime supremacy. The Government remained adamant in face of this appeal, and the position having been dealt with by Mr. Neville Chamberlain from the steelmakers' point of view, the amendment was rejected by a large majority. The question is a complicated one, and is not, as some have suggested, a simple case of robbing Peter for the benefit of Paul.

Oil Fuel Depot at Jarrow.

Good progress is being made with the work on the new oil fuel depôt which is being formed on a site adjacent to Jarrow Slake. Two companies—the Shell-Mex and the British Petroleum—are the prime movers in the project. The first-named is constructing two tanks of 8000 tons capacity each, and a smaller one of 4000 tons capacity as a first instalment, and the British Petroleum Company has commenced operations on an adjoining site. The Whessoe Foundry, Limited, hopes to have one of the Shell-Mex tanks completed in the autumn, and progress with the whole scheme will be expedited when the new jetty which is being built by the river Tyne Commissioners at this point on the river is available. Pipe lines will connect the jetty with the storage tanks, and vessels desiring to obtain supplies of oil fuel will berth in deep water alongside the jetty. Dredging operations are at present in progress.

Secret of Hardened Bronze.

According to information just to hand from the United States, the old Egyptian process for hardening and tempering bronze has been re-discovered. It is claimed, indeed, that the new bronze possesses remarkable qualities with regard to tensile strength, resistance to electrolytic action, and in its behaviour as a bearing metal. Other statements have emanated from those associated with the invention which have aroused the interest of engineers. These claims will naturally have to be demonstrated under service conditions before engineers—who are difficult people to satisfy—will endorse all of them. Without applying the observation to this particular case, there is a natural disposition on the part of inventors, like the lady in the play, to protest too much.

Municipal Contracts for Foreign Firms.

Some feeling has been aroused by the placing with Brown, Boveri and Co., Limited, of a contract by the London County Council for a new 8000-kilowatt turbo-generator, which is required for the Greenwich power station. The reason given for this action is that the foreign tender was £8000 less than the lowest British tender, although British firms were given an opportunity of amending their quotations. The subject was raised in the first instance through a protest of the British Engineers' Association, it being pointed out that 80 per cent. of the contract price would have been distributed in salaries and wages. It has since been discussed mainly in the form of question and answer with supplementary interrogations in the House of Commons, the argument used being that had the contract been placed with a British firm even at the higher price quoted, it would have saved an unproductive expenditure on unemployment pay of a greater amount than the difference between the foreign and British tenders. The official reply was that no action could be taken by the Government. Nobody anticipated that the Government would find any ground for interference with the discretion of local authorities in the placing of contracts for material, but, nevertheless, the issue raised is a most important one, involving economic and ethical considerations of a somewhat complicated kind. It will be sufficient for the moment to record the facts, which throw a strong light on the question of production costs in the British engineering trades.

Railways Bill.

Great hopes are entertained that the new era of the railways, which commences with the passage of the Railways Bill, may achieve the desired result of giving the country the benefit of efficient railway transport at reasonably low rates. That cannot happen for some time to come, as rates are to be fixed at a level to yield a standard revenue equal to that which has until now been guaranteed by the Government, and rates must for the time being remain at the highest level consistent with the free use of the railways for passenger and goods traffic. Sir Eric Geddes has undoubtedly shown great skill and has greatly increased his reputation as a parliamentarian in piloting the Bill through the House of Commons. He has had to face a good deal of opposition, much of which was directed against the principle of fixing charges with the object of raising a standard revenue. This was stigmatised as an unsound principle, and the Minister of Transport practically admitted the accuracy of the criticism. There had, he intimated, however, been no suggestions of a practical nature for an alternative method of securing the solvency of the railways. Some of the most bitter opponents of the Bill spoilt their case by exaggerated denunciations and charges which could not be substantiated.

Japanese Submarines.

Comment has been caused in naval engineering circles by the report that the Japanese Government has placed an order with Sulzer Bros. for Diesel engines to the value of £1,250,000, which are to be installed in the new super-submarines. Only bare details are available, but they indicate that the engines are to be of 4000 horse-power, and that it is intended to equip each of the new submarines with engines aggregating from 16,000 to 20,000 horse-power. A similar order, but for engines of a lower horse-power, has been placed with the same firm by the United States Government.

Steel Output.

Complete figures for the steel output of the chief producing countries last year cannot yet be obtained, but some interesting statistics were given by Mr. Baldwin in the House of Commons in reply to a question on the subject. The United States produced last year over 36 million tons of pig iron and nearly 41 million tons of steel, Great Britain being a bad second with 8 million tons of pig iron and 9 million tons of steel. The German figures, which are only a rough estimate, are given as 7 and 8 million tons respectively, and the combined production of France, Belgium, Spain, Italy, Canada, Sweden, India and Japan as about 7 million tons of steel. Viewed in the light of these figures, our position is more hopeful than was generally believed, but the recent optimistic forecasts as to the future of the iron and steel trades are regarded by some authorities as altogether exaggerated. The situation has improved, but the competition of continental manufacturers is still causing a great deal of anxiety.

Wages in Railway Workshops.

From some points of view it seems a pity that the Amalgamated Engineering Union, which has a number of railway shop workers among its members, should have declined to be represented at the conference in London on Tuesday to consider the wages and working conditions of skilled craftsmen employed in railway engineering shops. The unions represented were the National Union of Railwaymen, the Federation of Engineering and Shipbuilding Unions, and the National Federation of Building Operatives. The main question which came up for discussion was the application of the 6s. a week reduction agreed upon by the engineering trades to the men in the railway shops, and it was decided that this should come into force on August 15th, when the second instalment of the reduction of 3s. a week is due throughout the general engineering trades. Other questions, including overtime, night shift and district rates, are to be dealt with by arbitration. The abstention of the A.E.G. is due to a refusal to recognise the right of the N.U.R. to negotiate on behalf of engineering workers, and to a belief that a policy of dealing direct with individual companies, which has been carried to a successful issue in the case of the Great Central Railway, is to be preferred. The advantage of such a method is that some of the questions which were left over at Tuesday's conference can be settled in the light of the particular conditions in each case.

Australian Air Mail Services.

It was recently announced that the Federal Government has placed a contract for a weekly aerial mail service between Geraldton and Derby, a distance of 1200 miles. This is the first official air mail in Australia, and is understood to involve the payment of a sum of £25,000, although the period over which this guarantee is to extend has not been stated.

Civil Aviation in Germany.

The extent to which the German Government is fostering civil aviation is not generally recognised, and the information given by the Secretary for Air on this subject in Parliament will open the eyes of many people. Remarkable progress is being made having regard to the restriction on aircraft construction imposed by the Peace Treaty. There are in Germany two main bodies which virtually control all air traffic—the Deutsche Luftreederei and the Nord Deutsche Lloyd. The latter comprises some eight or ten companies—the most important of which are the Rumpler, Albatross, Sablatnig, and Junker concerns. Large numbers of societies have been founded throughout the country with the object of stimulating interest in, and promoting the development of, aviation in all its civil aspects. The Government is indirectly represented on the "Flug and Haven," which is the most influential of these institutions. Although prohibited by the Allied authorities from running air services outside Germany, a number of internal air routes are in operation, and a considerable sum has been allotted by way of Government subsidy. All the services, the majority of which are based on Berlin, are being maintained by about 100 old military machines which the operating companies have been allowed to acquire.

Fixed Nitrogen Industry.

The statistical supplement to the report of the Nitrogen Products Committee, which has been issued during the week, reveals the unpleasant fact that in spite of the great increase in output from the fifty plants now in operation, there is still no plant in the United Kingdom, and only two in the British Empire. Expressed in the concrete form of figures, British firms could produce 12,800 tons a year out of a total world's productive capacity last year of 671,300 tons. Germany is predominant in the industry, producing by various processes twice as much nitrogen as the rest of the world. By fixation processes the capacity of German plants is 424,000 metric tons a year, and that of the rest of the world 237,000 tons, of which Great Britain does not contribute a single ton. The Committee rejects the complacent theory that Great Britain, by holding back during the experimental period, may reap an advantage. The plain truth is that while other countries, especially Germany, have carried their experimental work well into the productive and commercial stage, we are still engaged in constructing plant and debating the merits of the processes of German, French, and other chemists.

German Locomotives for Roumania.

It is understood that the Roumanian Government is giving favourable consideration to an offer from Germany of railway engines which, under the terms of the Peace Treaty, Germany has to pay for the redemption of the paper money issued through the general Roumanian bank during the German occupation. The offer of locomotives has been made to other Allied nations, and has naturally been regarded with considerable suspicion. The view taken in certain quarters is that the acceptance of material must have a harmful effect on the industries of Allied countries engaged in the manufacture of locomotives or other engineering products which may be offered, in the same way as the handing over of German ships has affected the shipbuilding industry.

Scotch Water Power Schemes.

The latest plan for the utilisation of water powers in Scotland is now under the consideration of the Ayr Town Council. Details of the scheme which have been submitted are not available, but it is understood that the proposal is to make use of the Loch Doon area. The estimated cost of the scheme is £250,000. Although one or two important hydro-electric schemes have already been developed in Scotland by well-known industrial interests, among which may be mentioned the Lochaber and the Grampian undertakings, this is, we believe, the first occasion on which a Scottish municipality has had before it a definite plan of this character.

Well House Foundry, Leeds.

THERE are not many machine toolmaking firms in this country that can lay claim to an earlier beginning than that of Joshua Buckton and Co., Limited, the works of which, known as the Well House Foundry, in Meadow-lane, Leeds, date back to 1838. There, on the site of the present extensive works, the late Joshua Buckton first commenced to construct machine tools in buildings which were originally erected for a wool warehouse. Mr. Buckton virtually lived on the site in a house that was already in existence when he started business. The early order books which are still in the possession of the firm clearly indicate the class of work which was undertaken. It consisted of machine tools of all kinds, shearing machines and steel works plant, much of which was supplied to engine building firms and railway companies. Amongst the latter are to be found the names of undertakings which have now only historic interest, such, for instance, as the York Railway Company, the Edinburgh and Northern Railway Company, the West Hartlepool Harbour and Railway Company, the Leeds and Thirsk, York, Newcastle and Berwick, the Newcastle and Carlisle, the West Cornwall, the Leipzig and Dresden, and the Brunswick Ducal Railway Companies.

The firm was registered as a limited liability company in 1883 under its present title, the first managing directors being Mr. Joseph Hartley Wicksteed, Mr. W. W. Lupton, and Mr. T. A. Carpenter. Mr. Buckton died in 1895 and Mr. Wicksteed became chairman of the company, over which he continued to preside until his retirement in 1918, when he was succeeded by Mr. Christopher James, who had been managing director for many years. The other present directors are Messrs. H. E. Carter, Basil T. Courtney, M.I. Mech. E., and Major F. L. Watson, M. Inst. C.E., M.I. Mech. E. Thus, including Mr. N. D. Lupton, who recently retired from business, there have been only nine directors in thirty-eight years. Although originally it made almost every variety and size of machine tool, the firm has of late years turned its activities especially to machines of the heavier and more powerful classes. Prior to the war it had built many heavy tools, such as gun lathes, for the arsenals. During the war period the company's resources were entirely devoted to the construction of machine tools for war purposes, the products being special gun and shell machinery. Since the Armistice the works have reverted to their regular products, namely, heavy machine tools and testing machines, the latter of which are a speciality of world-wide reputation associated with the name of Wicksteed.

works, covering an area of 15,200 square yards, are now organised on the principle of grouping together all machines of a similar type. With that object the reciprocating tools, such as planing, shaping and slotting machines of all sizes, are concentrated in one department, the lathes in another, while the drilling and boring machines are distributed about the fitting and erecting shops in order to reduce the movements of heavy parts from one place to another.

The offices front on to Meadow-road. On the ground floor are the timekeeping department, the costing and purchasing departments, and the works managers' offices, all communicating directly with one another. On the first floor the accounts department, correspondence office, directors' offices, and drawing-office are found in the order mentioned, with direct communication throughout so as to save walking time on the part of the staff. The top floor has room for the storage of drawings and documents not in regular use. There is also on this floor a well-equipped photographic studio containing an electric printing apparatus for drawings and everything essential for the production of photographs of the firm's machines. In this connection it may be mentioned that Mr. Joshua Buckton claimed to be the pioneer of photographic illustration of machine tools.

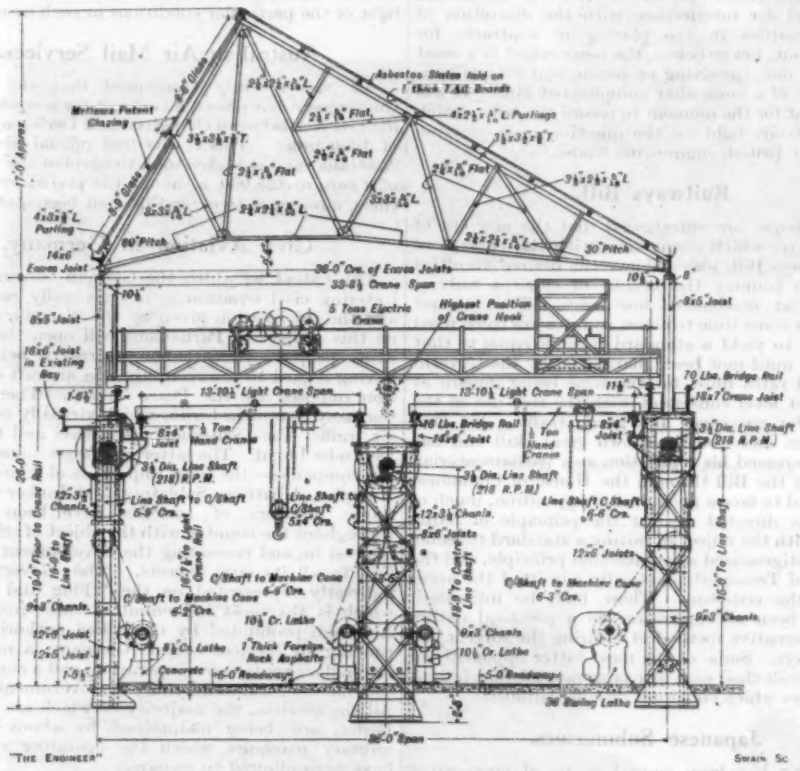


FIG. 4—CROSS SECTION OF NEW TURNING SHOP

Passing from the offices into the works we come first to the new pattern shop, a lofty and commodious building measuring 150ft. by 24ft., with the front entirely of glass to give ample light—see Fig. 6. The woodworking machines for this department are in a building at the end of the pattern shop and, in common with all the plant in the works, are driven electrically. The next building beyond the pattern shop is the original four-storey warehouse existing in 1838, which now fulfils a useful purpose as a general store for materials and small goods to be used in the works. In the same line of buildings are the case-hardening and smiths' shops, the latter containing steam and pneumatic hammers. At the far end of the yard is the foundry, which consists of two buildings recently thrown into one in order to give more floor space for the production of small castings while allowing the space in the main building for heavy work. The foundry is equipped with two overhead cranes, a large core stove, three cupolas, and the usual sand grinding and mixing machinery. It is, so we are informed, capable of producing individual castings up to 25 tons in weight. The yard space in front of the foundry is utilised for the storage of various classes of pig iron and coke. A square building in the middle of the yard which was once the firm's foundry is now adapted to fettling purposes. Following the boundary of the site there is a range of buildings recently acquired by Messrs. Buckton for the purpose of extensions, but used meantime as pattern stores.

Immediately to the west of the foundry is the boiler-house, containing a Lancashire boiler, the purpose of which is now solely to supply steam to the hammers and heating apparatus. Next to the boiler-house is the engine-room, containing a horizontal steam engine kept as a stand-by in case of failure of the electric power supply derived from the Corporation mains. The same house contains the hydraulic pumps and a motor transformer. The current supplied by the Corporation being of the alternating variety, it is necessary to transform a portion to direct current for use by the electric cranes and machines driven by variable-speed motors. Adjoining these departments are the main shops, the most southerly being the new turning shop—Fig. 4—measuring 258ft. by 36ft., with an annexe containing automatic and capstan lathes. As will be seen from the drawing, Fig. 4, and the half-tone engraving, Fig. 7, the main turning shop has three line shafts extending from end to end, each being driven midway in its length by an alternating current motor of 50 horse-power. This building is a steel structure with brick footings, the roof being of the right-angled saw-tooth type, close boarded and covered with asbestos tiling on the south and glazed on the north side. The two outer line shafts are carried on the main structure of the building and the central shaft is supported on a gantry very strongly and rigidly constructed of steel joists and channels. Provision is thus made for driving four lines of lathes, with ample working space for the men and for the handling of materials. Running the whole length of the shop and spanning right across it is a 5-ton electric overhead crane, and spanning each half of the shop from the gantry to the side girders are hand-operated cranes capable of lifting 30 cwt. These latter cranes are at the individual disposal of the turners. In this shop we noticed lathes from 6½in. to 18in. centres, many of which are quite new. There are also cylindrical and surface grinding machines, the practice of finishing spindles and shafts by grinding having been definitely adopted by the firm. There is a number of gear-cutting machines of various makes, the latest being of the Sunderland type.

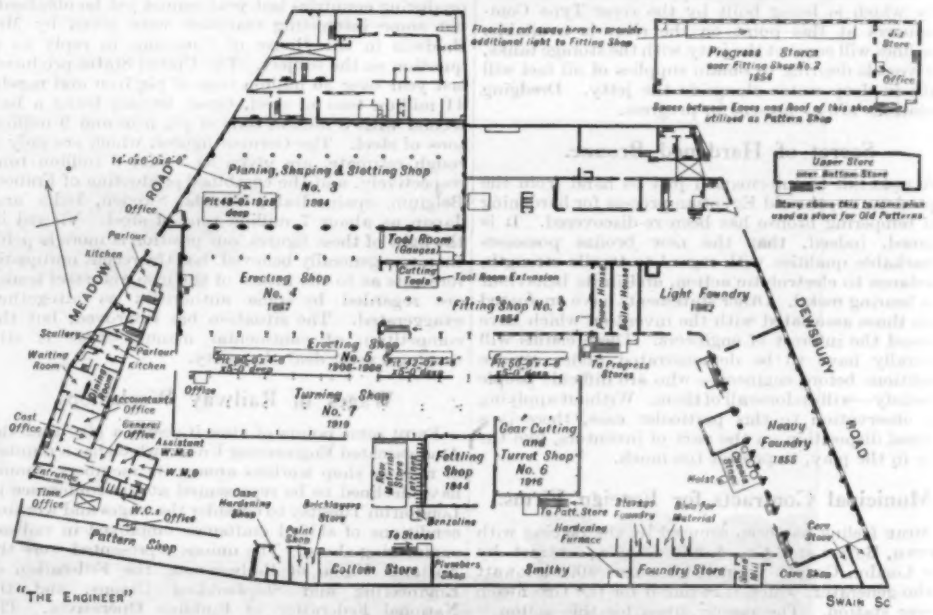


FIG. 5—PLAN OF WELL HOUSE FOUNDRY

Here it should be mentioned that Messrs. Buckton have for some years adopted a special stub tooth form of their own. It is of the short involute variety, and consequently the cutters used are made specially to produce it. In the early days of the firm and before the introduction of machine-cut gearing Messrs. Buckton made a special feature of cast gearing

The plan, Fig. 5, gives a very good idea of the growth of the establishment from its early days to the present, the dates of erection of the various buildings being given. An inspection of the buildings provides an object lesson in the evolution of factory construction from the days when wood and cast iron were chiefly used, to the present days of rolled steel and concrete. The most recent extension—it has been carried out since the termination of the war—consists of a new turning shop, to which we shall refer again later. The

which was noted for its accuracy. As far back as "the 'forties" they constructed and sold wheel-cutting machines designed for the accurate production of patterns for cast teeth. It will be seen, therefore, that accurate and well-designed gearing is no new thing in these works, and the present practice of machine cutting gear wheels has been evolved through many years of study of the subject.

Adjoining the turning shop is the light erecting shop—see Fig. 8—which at the time of our visit was chiefly occupied by testing machines and machine tools under construction, the latter ranging up to 20 tons in weight. The shop is served by 7½-ton overhead electric cranes. Next to it again is the erecting shop for the heavier tools—see Fig. 9. It is served by a 25-ton overhead electric crane and has direct communication with the fitting shop, where detail parts are prepared for the erectors. In the tool-room adjoining the cutting tools, reamers, drills, &c., are made and stored, being kept in order, checked and issued to the workmen as required. The same department takes charge of the limit gauging system, which is in universal use throughout the establishment, in spite of the fact that repetition work as usually understood is conspicuous by its absence. Messrs. Buckton's work is almost exclusively individual and covers a wide variety of machines built to comply with special requirements. Nevertheless the proprietors are firm believers in the advantages of limit gauging. The gauges are issued from the tool-room only as required for the jobs in hand. They are returned to the same department on the completion of each job, carefully checked and, where necessary, adjusted before re-issue. Very accurate measuring apparatus is made use of for this purpose, and its use is confined to a very limited number of persons, thus, as far as possible, eliminating variations due to the human element. The working drawings indicate whether the parts of machines are to be made a running fit, a keying-on fit, &c. Suitable "go" and "not go" gauges are then issued to the borers and turners, who do not need to be further concerned with the exact dimensions of these parts, saving, of course, to make the work to the gauges issued. The next shop contains all the reciprocating machine tools, such as planing machines, varying from those capable of dealing with objects from 3ft. wide by 3ft. high up to 12ft. wide and 10ft. high, slotting, shaping and boring machines. This shop is served by a 20-ton overhead travelling crane. All the machines in this section, as well as all the larger lathes and drilling machines, are of Buckton's own make. The individual motor drive is adopted for the planing machines, the larger machines being provided with reversing motors and the smaller ones with constant-speed motors and change-speed gear-boxes. A certain amount of erecting work is also performed in this department, which serves as an overflow to the main erecting shop. Over the fitting shop is a large store-room where finished and semi-finished parts of machines are stored under the charge of a foreman and re-issued when required for further processes. This obviates the confusion, loss and deterioration which ensues in some shops in which finished work is allowed to lie about the shop. The northernmost portion of the works comprises a block of buildings, the upper storeys of which are used as pattern stores and the ground is fitted up as a comfortable and commodious canteen. The latter is divided into two sections with the kitchen in between, the larger portion being used by the workmen and the smaller side for the office staff and foremen. The canteen is managed entirely by a committee of the employees, which fixes the prices of consumables, makes the purchases, and has general control of the arrangements. It says much for the management that practically all the firm's workers who do not live near enough to the works to go home for their meals, and many who do, patronise the canteen.

Amongst the machines which were in course of construction and approaching completion at the time of our visit was a three-headed locomotive frame plate slotting machine capable of dealing with plates up to 45ft. long by 6ft. wide, and having a cutting stroke of 20in. This machine is illustrated by Fig. 10 on page 170. It has a separate motor drive to each head, compound quick-return motion, and quick and slow power traversing gear for moving the slotting heads along the table and the saddles along the heads. It has also a gear for varying the length of the stroke without stopping the machine.

Fig. 2 on page 164 shows a 50in. centre heavy sliding and surfacing lathe, admitting 16ft. between centres. This lathe will swing 84in. diameter over the saddles and has a face-plate about 10ft. diameter provided with heavy screw jaws which are detachable when not required. The drive is through double, treble, and quadruple gear, the last pinion engaging in an internal ring of gear on the back of the face-plate. The changes of gear are effected by handles on the front of the headstock, the arrangement being such that no two gears can be put in opposition. The bed is of three-shear box section and carries two saddles with independent variable-feed motion for sliding and surfacing, the stopping, starting, and reversing of the feed being effected on the saddle itself. The loose head-stock centre is set up by a geared screw. The machine is driven by a 35 horse-power direct-coupled variable-speed motor, giving with the gear changes in the head-stock a wide range of cutting speeds for different classes and diameters of work.

Another machine which had just been completed was a 400-ton testing machine, which is shown in Fig. 3, page 164. It was designed for carrying out breaking tests on three-link lengths of chain cable up to 4in. diameter, and for proving anchors up to about 10 tons weight. It will admit a maximum stretched length of 16ft. and will take in anchors up to 17ft. in length. The pull on the specimens is applied by a hydraulic cylinder which is at the same end of the machine as the weighing apparatus. The ram of this cylinder pushes a sliding bed to which the outer end of the specimen is attached by shackles. The inner end of the specimen is similarly attached to a cross-head which, through a bell-crank lever, transmits the pull on the specimen to a weigh beam on the top of the column of the machine. The weigh beam carries a

FIG. 6—NEW PATTERN SHOP

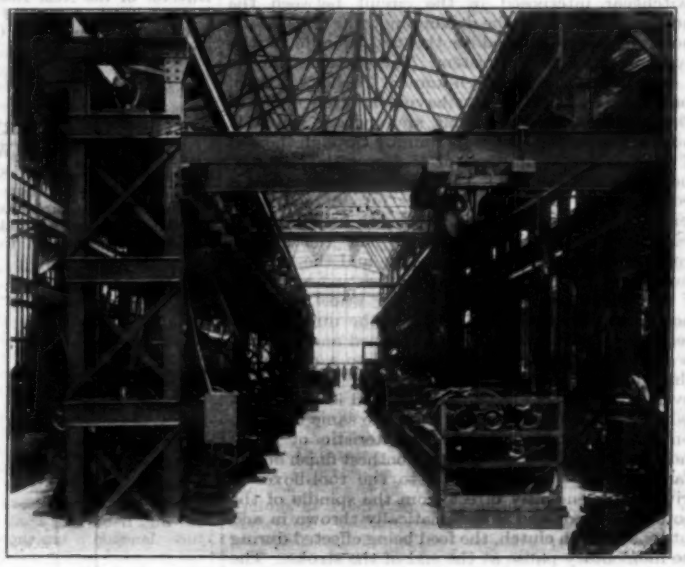


FIG. 7—NEW TURNING SHOP

FIG. 8—LIGHT ERECTING SHOP

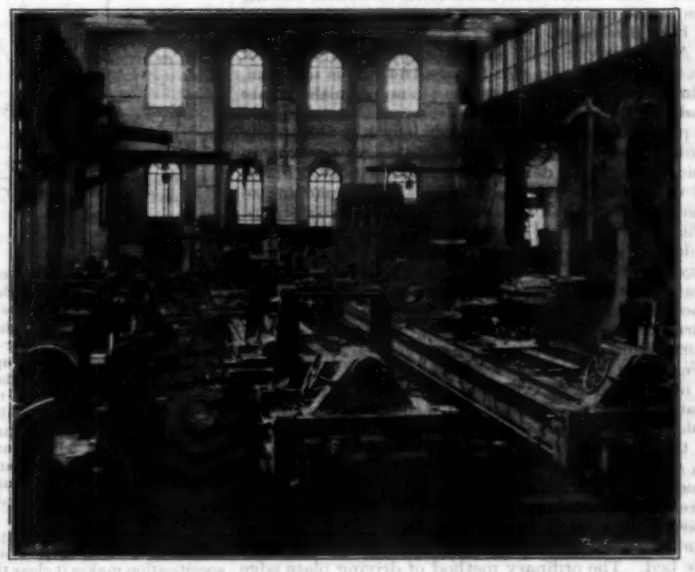


FIG. 9—ERECTING SHOP FOR HEAVY TOOLS

travelling poise weight with scale and vernier, which will read to the second decimal place of tons. To ensure accuracy in the readings thus obtained all the parts which transmit the load from the specimen to the weigh beam as well as the weigh beam itself have frictionless supports and frictionless fulcra, consisting of accurately ground hard steel knife edges on hard steel seatings. The knife edges and seatings are all readily renewable. Power for operating the machine is obtained from its own accumulator and motor-driven hydraulic pumps.

Fig. 11, page 170, represents a table planing machine to plane 8ft. wide by 8ft. high by 24ft. long. This machine has two tool-boxes on the cross slide, which are furnished with self-acting feed motions for horizontal, vertical, and angular cuts, and a tool-box on each standard having self-acting vertical feed motions and horizontal and angular traverse by hand. The machine is driven by a reversing motor set arranged on the "Ward-Leonard" system, in which the actual driving motor is actuated by the current produced by a motor generator set, the reversal and speed variations being obtained through switchgear interposed in the circuit between the motor generator and the driving motor. The driving motor is direct coupled to the first spindle of the Buckton spiral driving system. This system, which is a development of the well-known "Seller's" type, consists of a spiral pinion having a pitch angle of 45 deg., driving a plain cut spur wheel which is mounted on a diagonal shaft running through the bed of the machine at an angle of 45 deg. with the longitudinal axis of the bed. The diagonal shaft carries a second spiral pinion which gears into a rack fixed beneath the table, at least four teeth of the pinion being simultaneously engaged in the rack. The amount of gear between the motor and the table is thus reduced to its lowest limit, consisting as it does of only two spiral pinions, one spur wheel, and one rack attached to the table. Thus the number and weight of revolving parts to be stopped and reversed at each end of the stroke is reduced to a minimum, which effects a reduction in the power absorbed by reversal. A further advantage claimed is that backlash is practically eliminated. At the same time the continuous smooth motion characteristic of spiral and screw gearing ensures the smoothest finish on the planed work. The feed gear to the tool-boxes is driven independently direct from the spindle of the motor generator and is automatically thrown in and out by a friction clutch, the feed being effected during the momentary pause at the end of the stroke. The reversing motor drive is normally set to give a high quick-return speed combined with a cutting speed which can be varied to suit the nature of the work in hand. For work which lends itself to double cutting the motor can be set to give a suitable cutting speed in both directions.

A rack-driven 40ft. plate edge planer in course of erection is shown in Fig. 1, page 164. This machine, which is shown in the engraving in an unfinished state and without the holding-down beam, was designed to plane steel plates up to 40ft. in length at one setting and, when required, a pile of plates up to 12in. in thickness can be dealt with simultaneously. Plates of unlimited length can be fixed in the machine so that lengths beyond 40ft. can be planed at two settings. The normal cutting speed is 40ft. per minute. The saddle of the machine, which moves on broad sliding ways, carries, in additon to the tool slide and feed gear, its own motor and switchgear, which travel backwards and forwards with the saddle, collecting current from overhead wires fixed to the beam, on the same principle as the ordinary collector system of overhead electric tramways and railways. The motor is of the reversing type and the switchgear is automatically operated at each end of the stroke by adjustable stops on a rocking shaft running the full length of the machine. The saddle is driven to and fro by an arrangement of spiral gear similar to that used on Buckton's table planing machines, the motor driving direct on to the first spiral pinion and the second spiral pinion, whose axis is at an angle of 45 deg. with the vertical, engaging in a rack fixed on the front of the bed. The ordinary method of driving plate edge planing machines by a long screw has obvious inconveniences beyond a certain limited length of machine. The rack system with the motor travelling on the saddle is, however, unlimited as to length and can be applied to any size of machine which may be required to suit present or future developments as regards the length of plates which it may be necessary to plane.

THE INTERNATIONAL COMMISSION ON ILLUMINATION.

The first technical session of the International Commission on Illumination, the successor of the International Photometric Commission, was held in Paris from July 4th to 8th, at the building of the Société du Gaz. Belgium, France, Great Britain, Italy, Spain, Switzerland, and the United States of America were represented at the session, which was opened by the Minister of Public Works, who welcomed the delegates in the name of the French Republic. The British delegates, nominated by the National Illumination Committee of Great Britain, were:—Major K. Edgcumbe (Institution of Electrical Engineers, Chairman of the National Committee), Mr. C. C. Paterson (Hon. Secretary and Treasurer of the International Commission), Mr. A. P. Trotter (Illuminating Engineering Society), Dr. E. H. Rayner (National Physical Laboratory), Mr. L. Gaster (Illuminating Engineering Society), Mr. R. Watson (Institution of Gas Engineers), and Mr. J. W. T. Walsh (National Physical Laboratory, Assistant Secretary of the International Commission).

The subjects dealt with by the Commission were as follows:—

(1) The unit of candle-power at present in use in this country and in France and the United States was adopted for international purposes and is to be known as the "international candle." It is maintained by means of electric incandescent lamps at the national laboratories of the three countries named.

(2) The definitions of the terms "luminous flux," "luminous intensity," and "illumination," and the units of these quantities, viz., the lumen, the candle, and the lux (metre-candle) were agreed upon.

(3) The subjects of heterochromatic photometry—including physical photometry and the characteristics of the "normal eye"—factory lighting, and automobile head lighting were also discussed at the meetings, and sub-committees were appointed to study the questions from the international standpoint during the next three years.

The new President of the Commission is Dr. E. P. Hyde, Director of the Nela Research Laboratories of America; Major Edgcumbe is one of the three Vice-Presidents. The next meeting of the Commission was provisionally arranged to take place in New York in 1924.

BRITISH STANDARD SPECIFICATION FOR TRAMWAY TIRES.

A British Standard Specification for Tramway Tires (No. 101, 1921) has now been published by the British Engineering Standards Association. The profile of tread and flange originally standardised and issued in the British Standard Specification for Tramway Rails in 1903 has been retained, but in place of the varying widths of tire then provided to suit the British Standard Sections Nos. 1 to 5, one uniform width has been adopted suitable for rails having a tread of 2¼in., which dimension, we understand, is being recommended for the revised rail sections now under consideration and approaching issue. This width is that of the British Standard Section No. 4, probably the most extensively used of the Standard Sections. Three diameters of tire are provided for, namely, 32in. and 33in.—with thicknesses of 2½in. and 3in. respectively—for tramway driving wheels, and 22in.—with a thickness of 2½in.—for pony wheels, and the plate attached to the specification gives the finished sizes of these and the rolling allowances for machining. For the convenience of purchasers in countries in which the metric system has been generally adopted, approximate metric equivalents of the British measures are given, but a note to the specification makes it clear that the latter are to be regarded as the standard. The specification may be obtained from the offices of the British Engineering Standards Association, 28, Victoria-street, S.W. 1, or from Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4, price 1s. 2d. post free.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

BRICK CHIMNEY WITH CONCRETE CORNICE.

Sir,—I do not remember having seen a chimney built in the manner described by Mr. Moss, but there would be no added danger of the upper portion being "blown off" owing to its being bedded on concrete instead of fire-brick. There would, however, be considerable danger of failure by carrying the concrete through to the inside of the chimney, because at 20ft. from the base there would be too much heat in a chimney for a boiler as usually fired for the concrete to stand with safety.

If the concrete cornice was made in place in one block it would certainly crack, and if it was built up of several concrete blocks these would also crack if not protected with a lining of fire-brick. The concrete would also crumble away and perish by the heat on the inside of the chimney and so destroy the foundation upon which the upper cylindrical portion of the chimney depends for support.

Jos. H. Harrison.

Middlesbrough, August 9th.

VAAL RIVER BARRAGE.

Sir,—I beg leave to draw your attention to the following inaccuracy occurring in a paragraph under the "Miscellanea" heading of your issue of June 3rd last, page 595, relative to the Vaal River barrage. In the article in question you state the reservoir will contain over "13½" million gallons of water. This should read over "13,633,000,000" gallons of water.

I shall be obliged if you will kindly have this correction noted in your paper as soon as possible.

W. Ingham,
Chief Engineer, Rand Water Board.

Johannesburg, July 13th.

A DIAGRAM FOR TUBE SURFACE.

Sir,—For tubular apparatus like feed-water heaters and exhaust steam condensers, the type of diagram shown herewith should be useful when drawn to a larger scale with more detail and for a wide range of values.

The vertical scales for the square feet of surface obtainable with various lengths of tube between plates are placed to the left of line A B, at distances inversely proportional to tube length. Drawn across these vertical scales are oblique straight lines converging at B. They mark on each scale a point denoting a value in square feet, which is the same along any one oblique line throughout these scales.

The distances to the right of C D for the vertical scales denoting numbers of tubes of various diameters may be directly proportional to those diameters, so that oblique straight lines converging at D will show one number throughout with any one oblique line.

The upper horizontal dash line in the figure is drawn to illustrate the connection of values. Example: 266 tubes, ¾in. diameter, 6ft. length, giving 313 square feet. The lower dash line shows related values: 100 tubes, 1in. diameter, 12ft. length, giving 314 square feet of surface.

The outer vertical scales are meant for guidance in setting the straight-edge. After the selection and adjustment of main proportions by aid of the diagram, final precision can be checked by arithmetic.

London, W. 1, August 4th. A. C. Garwood.

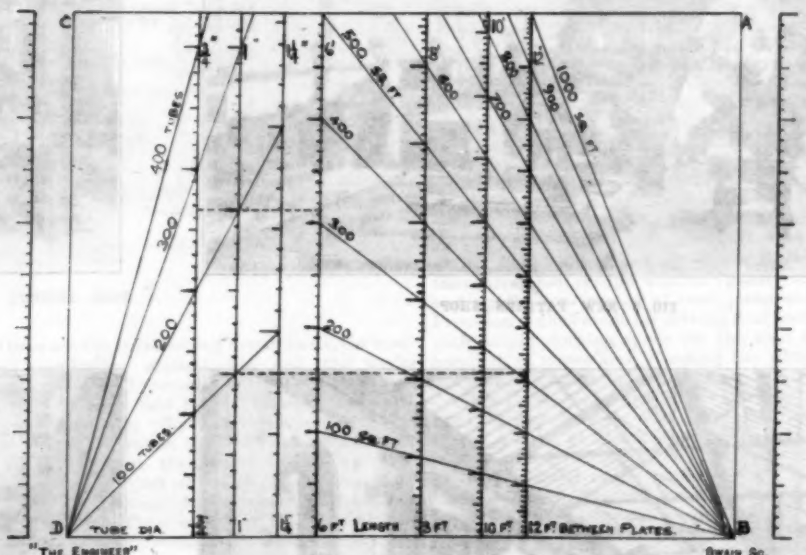


DIAGRAM FOR ASCERTAINING TUBE SURFACE

Lantern Slides.—Marshall, Sons and Co., Limited, of Gainsborough, will be glad to lend lantern slides, illustrating their steam engines, boilers, &c., suitable for lecture purposes at engineering colleges, technical schools, &c., during the coming winter session.

Technical Engineering Films.—Any firms which possess films dealing with technical engineering subjects, and which are prepared to lend them for the purpose of lectures to foremen, are requested to communicate with Captain R. Bruce Wycherley, acting district secretary of the Foremen's Mutual Benefit Society (Halifax District), Permanent Buildings, Commercial-street, Halifax, Yorks.

Iron and Steel Institute: Paris Meeting.—In accordance with previous announcements, the autumn meeting of the Iron and Steel Institute will be held at the headquarters of the Comité des Forges de France, 7, Rue de Madrid, Paris (in close proximity with the Gare St. Lazare), on Monday and Tuesday, September 5th and 6th, commencing on Monday at 10.30 a.m. and on Tuesday at 10 a.m. Alternative visits to works in Lorraine, in Burgundy and in Normandy have been arranged to take place at the conclusion of the meeting. The following is the list of papers which it is expected will be submitted:—(1) N. T. Belaiew, "Damascene Steel"; (2) E. L. Dupuy, "An Experimental Investigation of the Mechanical Properties of Steels at High Temperatures"; (3) L. Guillet, "The Situation of the French Metallurgical Industry in the North and in the East of France: Its Destruction and Reconstruction"; (4) K. Honda, "Does the Critical Point Depend on the Strength of the Magnetising Field?"; (5) A. Portevin, "On Constituents Found in Tungsten and Molybdenum Steels"; (6) A. Portevin and V. Bernard, "A Contribution to the Study of Coalescence"; (7) A. Portevin and P. Chevenard, "On the Characteristic Curves of the Heat Treatment of Steels"; (8) P. Nicou, "Iron Ore Deposits of Eastern and Western France"; (9) E. Schneider, "An Investigation of Various Forging Operations Carried Out under Hydraulic Presses," Part II.; and (10) Captain H. W. B. Swabey and R. Genders, "Manufacture of Shells in Canada during the War, 1914–1918."

Railway Matters.

The report stage of the Railways Bill was completed on Tuesday evening last, and the Bill was then read a third time.

The privately owned railway wagon received another castigation at the hands of Sir Eric Geddes when Schedule 5 of the Railways Bill was under consideration in Committee. On that occasion the Minister of Transport said that the privately owned wagon was one of the greatest curses of economical railway management.

An uncertainty having been expressed in some quarters as to whether the next International Railway Congress will be held, as arranged, in Rome next year, the *Railway Gazette* has been in communication with M. Weissenbruch, the general secretary of the International Railway Association, and learns that the programme is being definitely carried out and that the meeting will be held from April 18th to May 1st, 1922.

The Postmaster-General has issued a notice drawing public attention to the fact that for a fee of 4d., payable to the railway company, letters, not exceeding 3 oz. in weight, may be sent by rail and posted on arrival at their destination, or they may be called for. The letters must bear twopence in stamps in either event. This arrangement, which is of very old standing and yet little known, is especially useful for Sunday letters.

In our Journal page last week we mentioned the deputation that was to wait upon the Minister of Transport on the 4th instant as to a new railway tunnel under the Thames between Gravesend and Tilbury. The deputation saw Mr. Arthur Neal, the Parliamentary Secretary, who said it was unique to find a deputation which did not come for money, and he wondered if he had heard that correctly. The proposal would have to be considered in the light of the Railways Bill, as it would affect more than one group.

The report of the *Métropolitaine*, of Paris, for the year 1920 showed that although the receipts were 40 million francs above those of 1919, the expenditure had a greater proportionate increase, and thus there was a deficiency of 10½ million francs—the first deficit in the history of the railway. The higher fares charged led, in part, to a reduction in the number of passengers from 505 millions to 465 millions. The remarkable feature of the year's working was the cost of fuel. In pre-war days this was 4 million francs; in 1919 it was 22 millions; but in 1920 this rose to 57 millions.

A serious collision occurred on Saturday last, just after noon, at Selby, on the North-Eastern Railway. A North-Eastern passenger train from Bridlington to Leeds stood on the up platform line when the signals were lowered for the first portion of the 10.15 a.m. Newcastle to King's Cross express, drawn by a great Northern engine, to pass through on the up through line. Just as the latter train approached, the Leeds train started and fouled the path of the Great Northern train. A collision ensued, but there were remarkably few personal injuries. The most serious of the material damage was that of the signal-box, the contents of which was wrecked.

In this column of our issue of July 22nd we quoted what Sir Eric Geddes said in Committee on the Railways Bill as to the probability that all railway-owned workshops would, after the grouping, continue to find work, especially if all the privately-owned wagons were bought up. On the same clause—Clause 12—during the report stage an honorary member moved that the common user and co-operation in workshops should be confined to rolling stock and plant. He said that, as the clause stood, there was nothing to prevent the companies from becoming general manufacturers of almost everything that railway companies required. Sir Eric Geddes opposed the amendment, and said that any more monstrous proposal to put before the House he could not imagine. The amendment was negatived.

The three millions to be given to the Irish railways in settlement of their claims against the Government—mentioned in this column on July 8th—are in jeopardy. The financial resolution for this should have been passed on the 28th ultimo, but the Labour Party stated that it would oppose the vote unless similar facilities for discussing wages and conditions of service to what were given to British railways were installed in Ireland. The control of the Irish railways ceases, along with that of the British, on Sunday next, but their future having been left a question for the Irish Parliaments, they have none of the benefits the railways here will enjoy under the Railways Bill. The companies have, therefore, given notice to their men of a reduction in wages, and this is a factor to be contended with. It is expected, however, that there will be a National Wages Board of four representatives of the companies, four of the men, and an independent chairman, and that wages—which are on the same level, or nearly so, as on English railways—will be reduced by one-third. As soon as an agreement has been arrived at a financial resolution and a Bill will have to be submitted.

We regret to hear of the sudden death, when on a visit to Washington, of Mr. J. F. Wallace, who was the chairman of the Chicago Railway Terminal Commission. It is difficult to compress into a few lines the various activities of the seventy years Mr. Wallace lived. He began a railway career in 1869, and by 1904 he had been engaged in engineering work on several railways and had then filled the offices of engineer of construction, chief engineer, assistant second vice-president, assistant general manager, and general manager of the Illinois Central. In June, 1904, he became chief engineer of the Isthmian Canal Commission and prepared the organisation for the building of the Panama Canal. He did not hold that position long, and about 1906 we find him president and chairman of the board of directors of Westinghouse, Church, Kerr and Co. He left that company in 1914, and became connected with numerous other large enterprises, including Chicago Railway Terminal Commission. The latter is a body, of which Mr. Wallace was the chairman, for reorganising the whole of the railway termini in Chicago. He was the first president of the American Railway Engineering Association, and in 1900 was the president of the American Society of Engineers.

Notes and Memoranda.

It is noteworthy that an order for steel plates required for bridge building on the Canton Hankow railway was recently placed with a local firm at the price of 343 dols. per ton, while an American quotation was for 374 dols. per ton.

The Ministry of Mines at the Eskmeals Experimental Station is conducting a series of tests in connection with a new form of instrument for detecting the presence of fire-damp. The apparatus, known as a Methanometer, relies for its operation upon the expansion of liquid in a closed tube. The tests are as yet incomplete, and until the apparatus has undergone extensive trials underground, its practical value cannot be determined.

According to the Commercial Secretary to the British Legation at Copenhagen, a meeting is to be held in Christiania on August 19th and 20th, between representatives from Norway, Sweden and Denmark, to discuss proposals for the transmission of electrical power from Norway to Denmark. Two alternative lines of transmission have been mentioned, namely, *viâ* Göteborg across the Cattegat to Frederikshavn and from the south of Norway to Hirtshals.

The economical running of Diesel-engined motor ships is, states a contemporary, exemplified by the maiden voyage of the Seminole, recently built by Vickers Limited. She crossed the Atlantic west-bound in ballast, consuming only a hundred and thirty odd tons of oil on the way. When the chief engineer had calculated the probable consumption of fuel on the voyage back to the oilfields, he found that he could, with perfect safety, sell 200 tons of his bunker oil. This, of course, meant an appreciable profit.

The growth in the size and power of motor ships is indicated by the fact that there is now in service an oil-engined tanker with a deadweight capacity of 15,750 tons, the largest vessel of her class yet built. She is equipped with machinery of 4700 horse-power, and, according to the *Motor Ship*, in which a full description is given of this interesting craft, a speed of over 10 knots is maintained on a fuel consumption of only about 14 tons daily, or approximately one-third of the amount required in an oil-fired steamer of the same size and speed.

An extensive series of articles is appearing in *The Trans-Pacific* on the conservancy of the Yellow River, China. In the July issue there is a description of the scheme put forward by Mr. Freeman for preventing the river overflowing its banks. He proposes to build parallel lines of dykes in the flat country beside the river, with a channel between them. The river would then be turned into the artificial course and allowed to scour out a channel. Silt deposited at flood time would fill the spaces between the dykes and produce a solid bank about a third of a mile wide.

In an account of a journey to the new oilfield of Northern Canada, Mr. W. E. Edmonds says, in *Canada*, that boring is going on, with considerable prospects of success, at Windy Point, Great Slave Lake, and on Cariboo Island claims of the richest gold quartz have been staked. Indications of immense deposits of mica and copper appear everywhere, and one feels, he says, that the North would still be a land of illimitable riches even though not a barrel of oil should be taken out of it. Four miles above Fort Norman there are thin seams of lignite jutting out from the river bank. For many years this lignite has been burning with a faint bluish light, and trappers boil their kettles over the low flames. In spring, when the river rises, the waters drive the fire up the bank, but when the floods subside the fire comes down to its former position.

According to a booklet published by the Pocahontas Operators' Association, of West Virginia, the coal miners of that district broke away from their union in 1895. Since then there has not been a strike in the field. The most favourable working and living conditions, as well as the freedom guaranteed every individual, have attracted to the coalfield the highest class of workers in the coal industry. Frequent attempts have been made to invade this situation by radical agitators and union organisers, but without result. Personal contact between miners and managers shows plainly the gratifying assurance to the public that there need be no fear that, for many years to come, there will be another strike in the Pocahontas field. The earning capacity of the mine employees exceeds that in any other field.

In his comments on the explosion of a tube in a water-tube boiler at a mill near Shipley, the Engineer-Surveyor-in-Chief to the Board of Trade says that there appeared to have been only slight loss of thickness from corrosion of the tube, and that in view of the tensile strength of the material and the moderate stresses to which it was subjected, it seems probable that, in addition to the material being rather brittle, the tube was cracked longitudinally. Defects of this nature are very difficult to detect after the boiler has been constructed, and as such defects probably originate in the course of manufacture, very great care is required in the examination and testing of all tubes, both solid drawn and lap welded, intended for water-tube boilers, to ensure that the tubes are sound and free from flaws, and that the material of the finished tubes has the essential qualities of toughness and ductility.

A technical committee dealing with wireless telegraphy, which includes representatives of the five Allied and Associated Powers, namely, the United States, Italy, Great Britain, Japan and France, is at present meeting in Paris in order to examine certain points in connection with international arrangements which it is necessary to establish in order to promote the practical development of wireless telegraphy and wireless telephones. This Committee has been working continuously since June 21st, 1921. The questions dealt with have been of a most varied character, relating to all aspects of the science and technique of wireless telegraphy. Sub-committees have been appointed to deal with special aspects of these questions. It is understood that complete agreement on these different questions has been reached in spite of the fact that several different points of view have manifested themselves.

Miscellanea.

Some Japanese merchants have bought a large quantity of timber in British Columbia, and it is proposed to take it right across the Pacific in the form of a raft.

During a fire which broke out on July 31st at the Satory Camp, Versailles, the flames spread to a magazine containing 140 shells for 75 centimetre guns. The shells exploded, the fragments flying in all directions. By extraordinary good fortune only two men were injured.

What promises to turn out an unusually valuable oil shale discovery has been made, according to the *South African Mining and Engineering Journal*, on the farm Maviriestad, in the Ermelo District. An analysis of the shale that was recently made by Mr. R. H. Rundle gave an average result of over 20 gallons of crude oil per short ton of shale.

The Victorian Government is about to construct an eight-storey concrete building in a central position in Melbourne to be used as the headquarters of the Electricity Commission. The heating and ventilating of the structure promise to be models of electrical equipment. Two electric lifts, one hand-controlled and the other with dual equipment, will be installed.

During the year 1919 the Chinese Government granted thirty-two mining licences. Most of them were for coal, but there were two for copper, one for lead and copper, one for lead, and one for manganese. Besides these, Lung Hsie-yuich and others have recently organised a mining company for opening lead mines in Lai Yang, Shantung. The area comprises 425 acres.

Among minor Australian developments, either projected or in course of construction, are a 3-ton electric furnace for steel castings at the railway workshops at Newport, near Melbourne, and the extension of its operations, by a New South Wales company treating iron and steel scrap, to Western Australia, where a plant has recently been put down to supply the local requirements for steel.

A report from Christiania states that a Norwegian scientific expedition has left Norway for Jan Mayen Island. The expedition will establish a radio station at Jan Mayen Island, which is to be connected with Norway, and the station will be used for meteorological service. It is anticipated that weather telegrams will be sent regularly from Jan Mayen, which lies between Norway and Greenland.

Engineers representing the Mexican Government are making a survey for the proposed oil pipe line that is to span the Isthmus of Téhuantepec, having its Atlantic terminus at Puerto Mexico and its Pacific terminus at Salina Cruz. The proposed pipe line will be approximately 190 miles long. Preliminary estimates place the cost at about 20,000,000 dollars gold. Application for the concession was made by the Mexican Aguila Petroleum Company.

About twenty bars of gold, each worth about £1500, have been recovered by a Government salvage vessel from the wreck of the Laurentic, which was mined at the entrance to Lough Swilly when on the way to America with three millions of bullion. Immense difficulties have been experienced in reaching the bullion. The cruiser has broken up so much that the bullion has been pinned beneath many tons of wreckage, which has to be blasted and carried away to another part of the ocean. Consequently only stray bars of gold have been picked up. Before the summer is over, however, many more are likely to be recovered.

The town demand for electric lighting in China during 1920 altogether exceeded the supply, and existing plants were heavily overloaded, and small electric lighting sets, supplied almost entirely from America, were installed by many would-be consumers. There is a tendency in the more important establishments to install units of 1000 kilowatts and upwards, and it is reported that large numbers of orders have been placed for privately owned power stations. These developments have stimulated the demand for electrical accessories, fittings and lamps. Japan has captured the lion's share of the business in accessories of the cheaper kinds; while America has the largest share of the remainder. The lamp market is practically monopolished by the large factories in Shanghai and by Dutch and Japanese manufacturers.

The Prussian Chambers of Commerce have recently undertaken the issue of a monthly report respecting the situation of trade in various industries. In the report for June it is stated that business in small electric motors experienced a slight improvement in that month owing to the requirements of agriculture in motors for driving thrashing machinery. On the other hand, the demand for large motors, generators, and transformers further declined. The effects of the world crisis are also reflected in business in measuring instruments. The telegraph and telephone branches, as the authorities concerned are refraining from placing orders, have been working for stock for some months past in order to avoid discharges of men. It is added that the export trade suffered from the uncertainty arising from the world market crisis and the Customs and anti-dumping legislation.

Before the war Germany's principal market for prismatic field glasses was abroad. The products of this class of German manufacture enjoyed unusual popularity in the United States and Canada, to which about half of the output was sold. Other important markets were Britain, France, Italy, Austria-Hungary, Switzerland, Spain, Russia, and the Balkan States. A not inconsiderable trade was also being built up in South America and other overseas markets. During the war prismatic field glasses could only be manufactured in Germany on a limited scale. At the conclusion of the war, however, the manufacture of these articles was again taken up. Up to the spring of 1920 a big business was done, the manufacturers being unable to supply the demand. The greater part of these glasses was sold in Germany and the remainder in the Scandinavan countries, Holland, Italy, Spain, and Switzerland. The German manufacturers in this industry are in process of re-establishing connections in their former foreign markets, and are hoping to see their export trade soon again in full swing.

MACHINE TOOLS AT WELL HOUSE FOUNDRY, LEEDS

(*For description see page 166*)

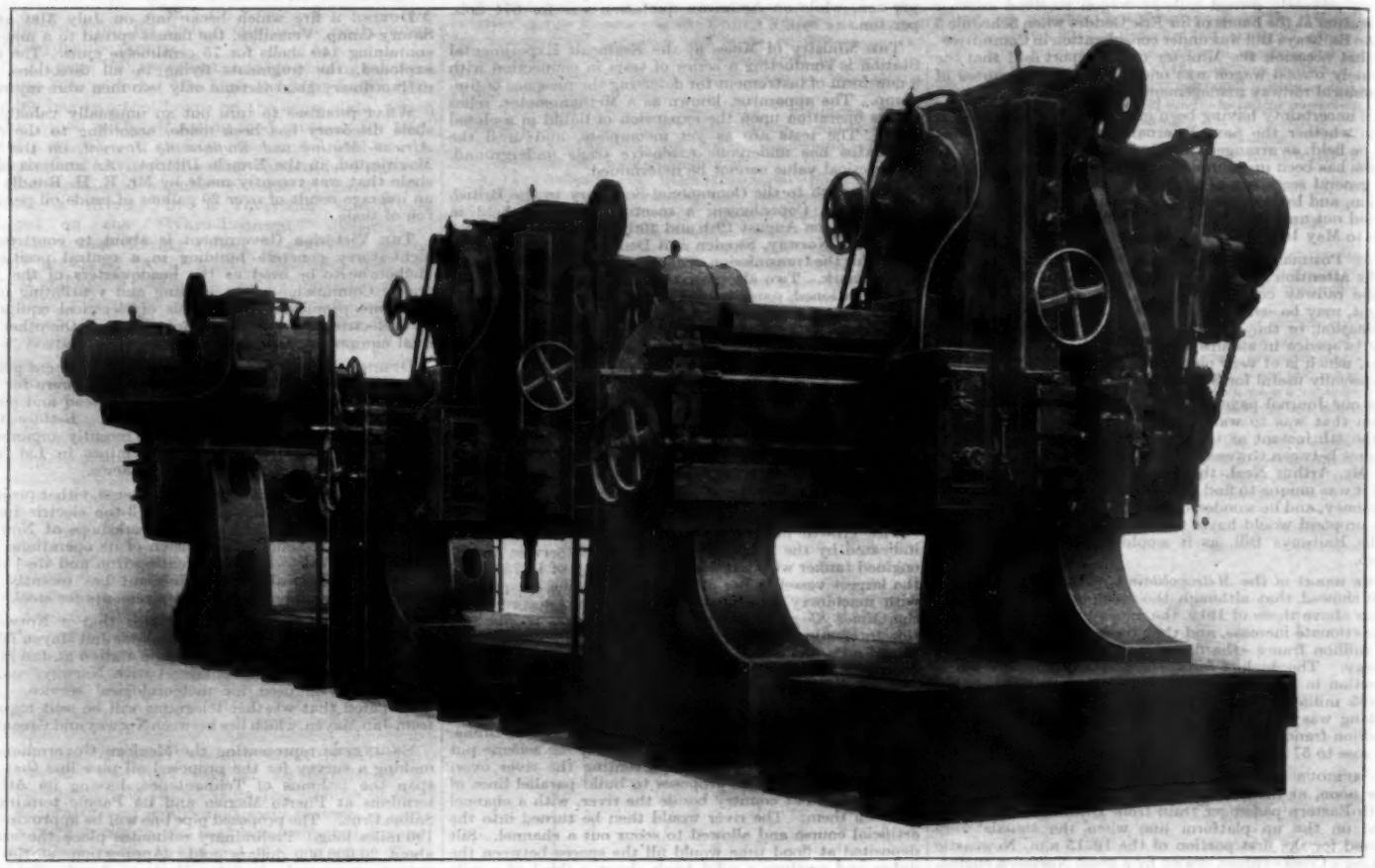


FIG. 10—45 FT. BY 6 FT. LOCOMOTIVE FRAME-PLATE SLOTTING MACHINE

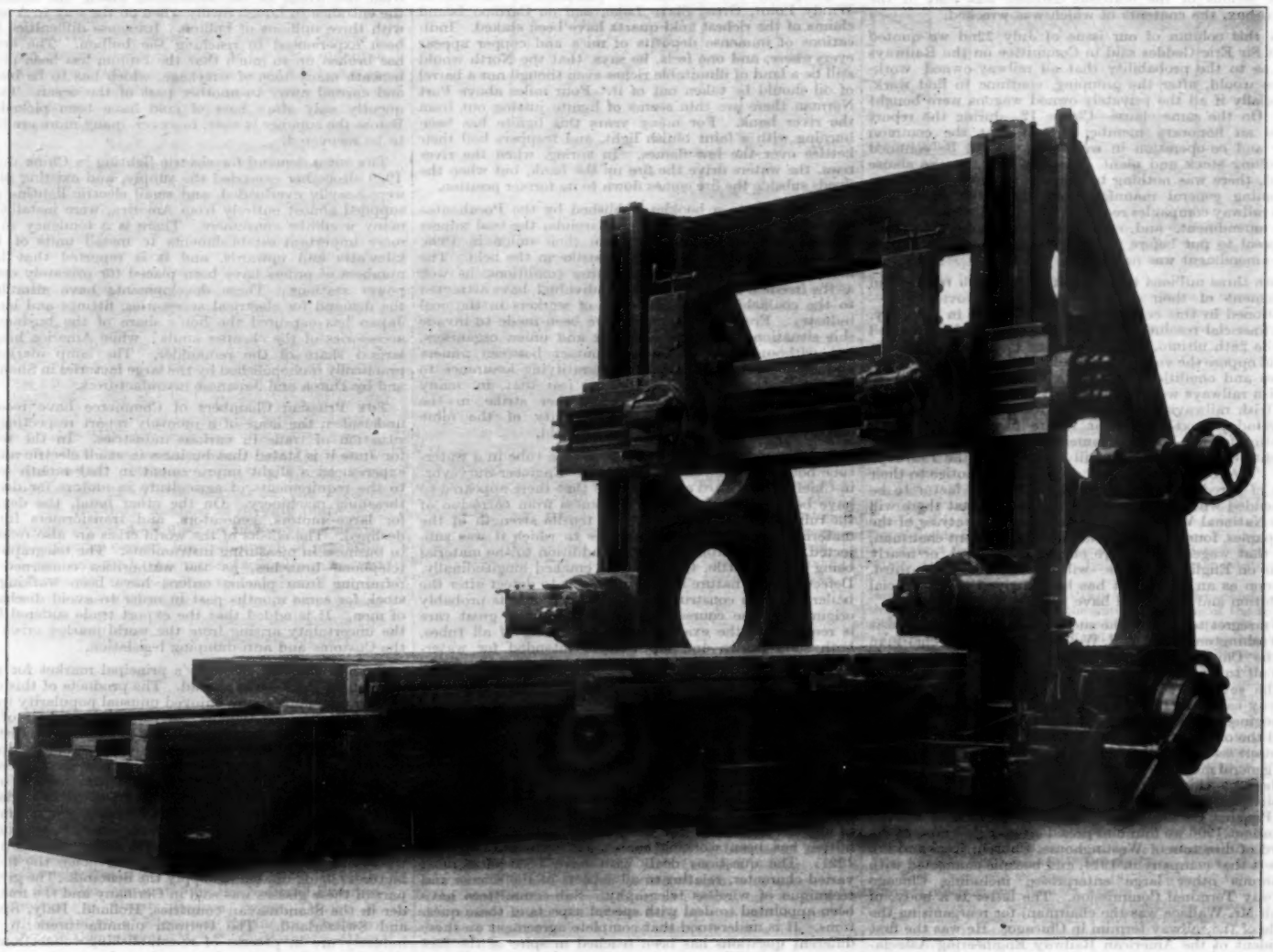


FIG. 11—24 FT. BY 8 FT. PLANING MACHINE

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*** *All letters intended for insertion in* The Engineer *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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THE ENGINEER.

AUGUST 12, 1921.

New Naval Construction.

In the House of Commons, last week, the ship-building votes of the Navy Estimates were agreed to, after a singularly interesting debate. Among the credits passed were those for laying down four capital ships to replace eight vessels which are becoming obsolete. The necessity of building these ships was made clear by Mr. Amery, Financial Secretary to the Admiralty, in his introductory statement. The Battle of Jutland, he explained, established a new and much higher standard of efficiency for the capital ship than had previously obtained, and other Powers had not been slow to take advantage of the technical lessons taught by that engagement. Japan and the United States are both at work on whole squadrons of new ships, individually superior in fighting power to the finest vessels of the British Fleet, with the possible and solitary exception of the Hood. In contrast with this marked activity abroad, heavy naval construction has been entirely in abeyance here for five years, with the inevitable result that our relative position at sea is steadily declining. Thanks to the exertions we made before and during the war, and no less to the fact that circumstances have delayed the carrying out of the American programme, our battle fleet momentarily retains its premier position; but its margin of superiority is shrinking so fast that it will have disappeared in a year or two, and from then onward the balance of capital ship strength will be against us. As that is a contingency which the naval advisers to the Government could not view with indifference, they felt it incumbent on them to urge the laying down of a minimum number of new ships, notwithstanding the grave financial sacrifice involved by that policy. The programme is certainly not excessive; it is doubtful, indeed, whether it can be considered adequate. If there were any prospect of our becoming embroiled with a great naval Power, the vote for new construction would be demonstrably inadequate. But since, happily, there are no serious clouds on the political horizon, the Admiralty has done well, perhaps, to limit its demand this year to four ships only. Twelve months hence the whole position will have to be reconsidered; but by that time the Washington Conference will have been held, and whether its issue be favourable or otherwise we shall be able to see ahead more clearly than is possible to-day.

In deciding to adhere to the capital ship as the principal unit of naval strength, the Sea Lords of the Admiralty have taken the only course that was open to them as trustees of the national safety. Those upon whom devolves the responsibility of defending a great Empire cannot be blamed for hesitating to throw away well-tried weapons, antiquated as they may appear to some, until an effective substitute has been found. In ten or twenty years' time the capital ship as we know her now may be as obsolete as the three-decker. But it is the business of the Admiralty to provide for national and Imperial defence by sea at any given moment, not merely at some remote period. That is a point too often overlooked by enthusiastic theorists in the realm of naval strategy. We may be—probably are—on the eve of revolutionary changes in methods of conducting warfare afloat, but few who have carefully followed the "great ship or——" controversy which has been waged since the Armistice will have the hardihood to assert that an absolutely convincing case has been made out on either side. On the whole, the balance of professional opinion has inclined toward the perpetuation of the capital ship, not because its limitations are unrecognised, but because it has so far held its own against all other claimants for supremacy. All who have paid the least attention to the subject are well aware of the possibilities that lie before submarines and aircraft. But whatever they may do in the future, the fact remains that they are not yet competent to replace the surface ship. As Viscount Curzon has opportunely reminded us, the Grand Fleet was not prevented from going to sea on one single occasion by the operations of enemy submarines. That being so, who can confidently affirm that the existence of many British submarines and aircraft, unsupported by heavy surface ships, would deter a hostile battle fleet from putting to sea to attack our coasts or ravage our trade?

It is to be regretted that the Admiralty is not yet able to publish particulars of the four new ships, though there are no doubt sound reasons for its reticence in this respect. Still, on reading between the lines of Mr. Amery's statement, it is possible to gain a rough idea of their essential features. Although described officially as "improved Hoods," it does not follow that they will be improvements on the archtype in all respects. They are, as we know, to mount a heavier armament—16in. as against 15in.—and as it is no longer a secret that the triple mounting is contemplated for these ships, they are evidently to be equipped with ten or twelve heavy guns apiece. The triple mounting, in addition to its tactical significance, has the advantage of economising weight, but however great the saving in that direction, it would not be such as to enable the designer to produce a vessel as fast and as well protected as the Hood, but carrying at least two additional big guns, on the same dimensions as that ship. This point deserves to be emphasised in view of Mr. Amery's remark that the dimensions of the new battle-cruisers "will be such as to keep within limits which will obviate the necessity of any larger docking or other accommodation being provided for them other than that already existing."

The Hood, it is well known, cannot be docked at Portsmouth or Devonport, and when in need of attention below the waterline, has to go to Rosyth, where the graving docks are just large enough to accommodate her. Now, it is clear enough that any ship designed to outclass the Hood alike in armament, protection and speed would have to be given increased dimensions. We conclude, therefore, that the Hood's successors will be inferior to her in some feature or other; and since the Admiralty's representative specifically refers to "improvements in the matter of protection and armament," the inference is that some sacrifice of speed has been accepted. Assuming this to be correct, it remains to be seen whether the official decision will be approved by students of naval warfare. Hitherto it has been a fundamental principle of British naval policy to design ships that are at least equal, if not superior, to foreign contemporaries, and any departure from this rule is certain to evoke criticism. It is not invidious to point out that whereas the Hood herself has a sea speed of approximately 31 knots, Japanese and American battle-cruisers now on the stocks are designed for 33 knots, if not more. It would, therefore, be somewhat difficult to justify a lower speed in British battle-cruisers of still later design unless there are good grounds for the assumption that the tactical and strategic value of high speed in capital ships has been depreciated by war experience. In noting Mr. Amery's assurance that the new ships have been designed with an eye to existing dock accommodation we are unpleasantly reminded of one of the gravest indictments preferred by Lord Jellicoe with regard to our pre-war battleships. After emphasising—in his book, "The Grand Fleet, 1914–16"—the disadvantage from which those vessels suffered owing to their narrow beam, which made them peculiarly vulnerable to underwater attack, he goes on to explain that "as each successive type of Dreadnought was designed, our constructive staff were faced with the fact that if they went beyond a certain beam the number of docks available would be insufficient. . . . It was one of the reasons which led to the German ships

being much better equipped to withstand underwater attack than were our own." And, he concludes, "it is devoutly to be hoped that this lesson will be borne in mind in the future, and adequate dock accommodation provided for the Fleet." We venture to echo this hope, without feeling too confident that it will be realised. In times of financial stringency there is always a temptation to adopt compromises, even when they involve risk. If the Admiralty were told that it could have money either for new ships or for new docks, but not for both, it would, in present circumstances, almost certainly elect for ships. But, in view of Lord Jellicoe's revelations, some official assurance that the all-round efficiency of our new battle-cruisers is not to be jeopardised by considerations of false economy would be welcomed.

Fatigue Testing.

Both from the practical and the scientific standpoint, the article on fatigue testing by Mr. Gough, of the National Physical Laboratory, which we publish elsewhere in this issue, is, we think, rightly to be regarded as a highly important contribution to the literature of this subject. The fatigue limit is now regarded by most engineers as a factor excelling in importance either the elastic limit or the maximum strength of structural materials. Hitherto, however, its practical value and use have been gravely discounted by the considerable length of time and the special nature of the machines required for its determination. In general, it may be said that, so far, the study of the fatigue of metals and the evaluation of the fatigue limit have been subjects purely for research laboratory investigation, and have not become to any degree a part of the routine of works testing. The promise contained in Mr. Gough's results is that fatigue testing will soon be adopted as a regular part of the testing practice of all works producing or using metals which are to be used under conditions in which a knowledge of the fatigue limit is of importance. The adoption of the methods indicated in Mr. Gough's article makes it possible to determine the fatigue limit of a specimen, with apparently great accuracy, in a period of time which need not exceed that absorbed in taking an ordinary tensile test. From anything up to a week or more the time required has been reduced to less than ten minutes.

The method of working is comparatively simple, and requires no great complication of apparatus. The procedure consists of applying a known range of stress to the specimen, of gradually increasing the range, and of noting the point at which the strain produced by the stress suddenly changes from increasing uniformly. This method of working was, we believe, first advanced in 1910 by Mr. J. H. Smith, who, using a tensile stress, showed that the stress at which the sudden change in the rate of increase of the strain occurred was substantially the same as the fatigue limit as determined for the same material by the ordinary lengthy fatigue endurance test. In 1914, Mr. Stromeyer suggested and demonstrated that the point at which the sudden increase occurred could be determined by applying a thermo-couple to the specimen, a small but definite rise of temperature being recorded when the point was reached. Mr. Gough has confirmed both Smith's and Stromeyer's results, and has shown that they are also applicable to torsional and bending fatigue tests. He found that, with care devoted to certain points, trustworthy indications of the sudden increase in the strain could be obtained by means of the Stromeyer calorimetric method. Greater ease and accuracy were, however, apparently secured by watching the growth of the strain by means of an optical extensometer. With the stress repetitions applied sufficiently rapidly the light reflected on to a screen by the extensometer mirror appeared as a steady band, the length of which gradually increased as the range of stress was amplified, until a point was reached at which the length suddenly shot up. In order to remove any misapprehension, it should be stated that the sudden increase occurred when the stress was still a long way below the limit of proportional extension of the specimen as determined by an ordinary static test. Comparison with the results obtained from the same metals under prolonged endurance tests of the orthodox Wöhler type showed that the sudden increase occurred when the stress applied had reached the orthodox fatigue limit. From the practical point of view there can be no doubt as to the importance to be attached to this new and rapid method of determining the fatigue limit of metals. From the scientific, the interest is no less great, for it seems to provide ground for a new or extended outlook on the causes underlying the phenomenon of fatigue. The fact, for instance, that the fatigue limit for a metal is generally much below the elastic limit as determined statically has never been quite satisfactorily explained. Why the metal under repeated stress should fail at a stress under which, when statically applied, the metal is still apparently completely elastic is difficult to understand. The results obtained and confirmed by Mr. Gough suggest that the statically determined elastic limit is artificially elevated, and that the true elastic limit is identical with the fatigue limit and is revealed after the artificially created internal condition has been released by the application to the specimen of a repeated stress.

That the Gough method—if we may call it so without detracting from the credit due to Messrs. Smith and Stromeyer—gives an accurate prediction of the fatigue limit as determined by the prolonged endurance or Wöhler process, will not be accepted by all without further experimental evidence. There is certainly insufficient proof as yet that it does do so with all the accuracy that scientific workers may demand. Some criticism in this connection has already been directed towards the fact that the accuracy of the Gough results is sought to be established by comparing them with endurance or Wöhler results determined on a basis of apparently not more than three million stress repetitions. The agreement revealed is remarkably good, but some authorities dispute the implied assertion that the true fatigue limit can be determined in anything under six million repetitions. Following this argument to its conclusion we might ask why we should stop even at six million repetitions. If the difference between the three and six million fatigue limits is sufficiently great to matter, can we have any faith that we have arrived at the truth even at six millions? Is there any assurance that the fatigue limit will not be found to sink lower and lower as the number of repetitions is increased, that in the end we shall be forced to the conclusion that there is no such thing as a fatigue limit, and that any stress, however small, will cause ultimate failure if it is repeated sufficiently often? From the hopeless position into which this line of thought would lead us we are rescued by Messrs. Smith, Stromeyer and Gough. If their experiments do nothing else, they show clearly a fact which the Wöhler method leaves us to infer, namely, that when the applied stress reaches the neighbourhood of the point which we call the fatigue limit something very definite occurs in the interior of the metal, a something modifying the elastic reaction of the specimen and simultaneously producing a rise in its temperature. From the scientific point of view the establishment of the occurrence of this change in the neighbourhood of the limiting fatigue stress would alone warrant our ascribing to Mr. Gough's results the importance that we do.

The Steam Locomotive of the Future.

The greatest single item of a railway company's costs are those connected with the running of its locomotives. In the past, railway travel has developed along the lines of higher speeds and more luxurious accommodation, both of which have necessitated the building of more powerful locomotives, meaning in turn a greater fuel consumption and increased running expenses. There is no indication that the future holds anything different in store; in fact, with growing competition from other methods of travel, railways may have to offer still greater facilities than they have in the past. Mr. H. A. Ivatt once remarked that when an engine was built big enough to pull a street of houses—or words to that effect—the traffic department always wanted to couple up the schools as well. Perhaps a hotel will be now required in addition. Who knows?

Compounds and Simples.

Speaking generally, the locomotive, unlike other steam engines, has resisted all the efforts of those who have sought to change it from simple to compound expansion. In making this statement we do not overlook the various compounds working on the Continent of Europe and in the United States, but compared with all the locomotives in the world, they form but a very small part.

The efforts of such eminent engineers as Webb and Worsdell in this country, Vauclain and Cole in America, and De Glehn and others in Europe are still fresh in our memory, and it almost seemed at one time that through their ingenuity the compound system was in a fair way to be practically established as a real means of reducing locomotive operating costs through economies in the use of fuel and water. Indeed, there is little doubt that under certain conditions compound engines did effect some economy in fuel consumption; but certain inherent characteristics mitigated against their general adoption, the chief of which was the falling off in economy as the working speeds became higher. Under the same condition the economy of the simple engine improved, and against that fact the compound was unable to contend.

At St. Louis several different locomotives were tried on the testing plant. Amongst them were four different compounds, each having four cylinders variously arranged. Throughout the range of the tests these engines showed an economy in steam consumption per unit of power developed when compared with simple engines. The performance of the De Glehn compound, as against that of a simple Pennsylvania "Atlantic," tested at Altoona, may be particularly noted. The compound consumed at a piston speed of about 500ft. per minute 20 lb. of steam, against 28 lb. used by the simple; but at 1100ft. the consumption of the compound had risen to 23 lb., as against somewhat less than 24 lb. used by the simple. The Vauclain and Cole compounds, whilst they both seem to have given generally better results than the De Glehn engine, showed by their curves of water consumption the same characteristics as the De Glehn engine, a point of more than usual interest, for the French engine had four sets of valve gear enabling independent adjustment of cut-off, and the American engines were not so fitted. Of the Vauclain and Cole compounds, the former gave the best results at the higher speeds, its water rate varying from 20 lb. to 21.5 lb. at piston speeds of 650ft. to 1250ft. per minute, the latter figure showing an economy of 10 per cent. over the results given by the simple "Atlantic" at the same speed, while at 650ft. per minute the simple engine required 24 per cent. more water than the compound.

The "Hanover" engine tried had, in addition to compound cylinders, the important advantage of a superheater furnishing "low degree" superheated steam. The curve of steam consumption for this engine was, in character, almost exactly similar to that of the "Cole" locomotive, but at 500ft. per minute, the speed at which it showed the least water rate, the consumption was 17.5 lb., and at 1100ft. this figure was increased to 19 lb. At the same speed the simple engine using saturated steam showed that it required just less than 24 lb. of water per indicated horse-power.

Superheating.

Since the introduction of the arch in the locomotive fire-box, no single improvement has, speaking generally, had such marked effects on the working of the locomotive from its economical aspect as the introduction of the superheater. Superheated steam has made the simple engine more economical almost throughout its entire range of ordinary working speeds than any compound experimented with on the St. Louis plant. Comparing the water rate of the superheated "Hanover" compound with that obtained with the latest type of Pennsylvania "Pacific" type locomotive using superheated steam, the results show that at a piston speed of 800ft. per minute the water rate for the simple engine was $17\frac{1}{2}$ lb., that of the compound practically the same, about 17.7 lb., whilst at 1200ft., 62 miles per hour, with 80in. drivers, and 28in. piston stroke, the water consumption of the simple engine was but 16.2 lb. against 19 lb. used by the superheated compound at 1150ft. per minute, the highest speed at which that engine was tried. At higher speeds of 1400ft. and 1600ft. per minute, the simple engine gave 1 indicated horse-power for a water consumption of 15.6 lb. and 15.1 lb.

Enough has been said to show that compound engines, even if supplied with high degree superheated steam, will have to show a considerable improvement in water consumption amounting to at least 15 per cent. at the higher rates of speed before they can compete with superheated simple locomotives in express passenger service.

Superheated Compounds.

From the fact that the water rate curves of both saturated and superheated compounds are generally alike in form, each displaying a similar increase in consumption with increase in speed, we gather that there is still room for improvement in the design and proportioning of compound locomotives, so far as the cylinder arrangement is concerned. Will the present pressing needs for economical working prompt designers to attempt again a solution of this interesting problem? We have on occasion seen it asserted that the express locomotive of the future will be a superheated compound, but considering the really wonderful results obtained with modern simple engines using highly superheated steam, we confess that at present we see no evidence of the re-introduction of the compound system into the practical politics of express locomotive design.

The Compound on Goods Trains.

So far we have dealt with express locomotives only. What is the position of the goods engine? Can we expect any economic advantage from the application of a superheater, and with it compound cylinders? In the United States practically all freight traffic is handled by simple engines equipped, of course, with superheaters. For very heavy "pusher" or assisting services, however, four-cylinder compound "Mallet" engines are the rule. These engines by the nature of their work operate at very low speeds, and thus

appear suitable for compound working. As a result, some remarkably low steam consumption figures have been attained, and, as we write, we have before us the published results of trials made with a large compound "Mallet" built for service on the Norfolk and Western in 1918. This locomotive at 8.16 miles per hour gave an indicated horse-power for 15.21 lb. of steam; at 10.5 miles per hour, 19.4 lb.; and at 12 miles per hour, 21.2 lb. were required. These speeds correspond to piston speeds of 260ft., 320ft. and 385ft. per minute.

Comparing the results obtained at St. Louis with the compound superheated locomotive with those obtained at Altoona with simple superheaters, we find that the compound used 10 per cent. less water than the simple superheated engines at low pistons speeds of 400ft. per minute, and at 800ft. per minute the consumption of the compound and the simples were alike. We gather from this that for freight service of a heavy character, moving at low speeds, compound engines, provided they are fitted with superheaters, might, from the point of view of fuel and water economy, profitably be employed. So far as practice in this country is concerned, and we write from this viewpoint, we can foresee certain difficulties of a practical nature, due to our restricted loading gauge, making it difficult for designers to find room for sufficiently large low-pressure cylinders. An alternative would be to use a six-cylinder engine having three low-pressure cylinders with their respective high-pressure cylinders superimposed, two sets outside and one set between the frames, with cranks at 120 deg. We make the suggestion being aware of its shortcomings; however, heavier train loads in the interest of economical working may yet enforce generally unlooked-for developments in locomotive designing.

Taking what we may call a panoramic view of the world's locomotives and considering their development on the various great lines in the old and new worlds, we think that engineers in this country have been in the van of progress. The multi-cylinder engine has been developed here to a point surpassing that attained elsewhere, and we believe with satisfactory results. For ourselves, while recognising to the full the benefits arising from the use of four cylinders, we are inclined to favour the three-cylinder engine as being a medium between the simplicity of the two-cylinder and the more complex four-cylinder locomotive for fast passenger service, and we are inclined to think that for our express services either the three or four-cylinder engine with superheated steam, using perhaps higher temperatures than we know to-day, will be the locomotive of the future. For freight traffic we may in time to come see the compound reappear, and it will have a superheater and will be built when we make up our minds to run heavier freight trains under the control of a continuous brake.

Obituary.

SAMUEL ALFRED VARLEY.

One of the pioneer workers in the electrical profession, Mr. Samuel Alfred Varley, passed away a few days ago at Winchester. Mr. Varley, who was in his ninetieth year, was the inventor of the self-excited dynamo, and in 1876 he took out a patent for a machine with two field windings, one of which was in series with the armature. The value of this invention was not apparently recognised until some years later, as the patent was allowed to lapse, but when a claim was made by one of the early electrical manufacturing firms for priority of patent rights for a compound-wound machine, it was decided by a Scots judge that Varley was the true originator of the system, and his patent was vindicated. In his young days Mr. Varley associated himself with the electric telegraph, and took part in the laying of the first Atlantic cable. During the Crimean War he was electrician in charge of the field telegraphs, this being, it is said, the first occasion on which the electric telegraph was used for war purposes. Mr. Varley was responsible for a lightning arrester for protecting telegraphs, and a communication system for enabling passengers to stop trains in the case of emergency. It is also said that he was the originator of the time balls at the Greenwich and other observatories. He was one of the first members of the British Association, and when he retired he was granted a Civil List pension in recognition of the services he rendered to the electrical industry.

Friction Tests on Bearings Lined with Frary Metal.

This following is the reprint of a report by the Engineering Department of the National Physical Laboratory on friction tests on bearings lined with "Frary" metal supplied by the British Ulco Company, Limited, Salisbury House, E.C. 2, for whom the tests were made.

This metal is a white metal, said to contain a very high percentage of lead, and it appears to have a rather higher melting point than the majority of white bearing metals. The bushes were lined at the laboratory in the presence of representatives of the British Ulco Company, Limited. No especial difficulty was found in lining the bushes, provided they were well tinned and kept thoroughly hot during the pouring of the metal. The bearings were in every case poured round a mandril smaller than the shaft and machined out to size.

Apparatus.

The first series of tests was made in a machine comprising two plummer blocks attached to an iron framework, which was suspended from the shaft. The shaft was mounted in fixed ball bearings and rotated by an electric motor. The friction of the test metal in the plummer blocks was measured by the torque required to keep the iron frame from revolving with the shaft. In order to obtain sensitivity, the frame was balanced by the addition of weights, so that its centre of gravity was in the axis of the shaft. The displacement of the loaded frame then gave no returning moment, and the whole friction torque could be balanced by small weights attached to scale pans on an arm carried by the frame. The effect of a small error in the balancing of the load on the frame was eliminated by keeping the arm in a constant position to a fiducial mark and by running tests in both directions of rotation. Under these conditions, if w_1 and w_2 are the observed scale pan loads, μ the coefficient of friction, W the load, R the radius to the scale pan, and r the radius of the shaft, then $\mu = \frac{1}{2}(w_1 + w_2)\,R/W\,r$. A record of the total number of turns of the shaft was kept from the readings of a counter on the end of the shaft, and the mean speed calculated for five-minute intervals and for the whole time of the test.

The last series of experiments was carried out in the machine shown herewith. In this machine, arrangements were made for working at much higher pressures and for supplying an excess of oil to the bush under test. The oil was supplied from a displacement cylinder which was separately driven by an electric motor, so that the flow of oil could be regulated independently of the speed of the friction machine, and also in order that the bearing could be flooded before starting the motion of the journal. In this machine a bush in a suitable holder was run upon a journal turned on the end of the shaft, and the load was applied to the frame by means of a lever and a parallelogram of links, so that a rotation of the holder about the shaft would not displace the line of pull from the axis of the shaft. By this means, very high loads—up to 10 tons—could be applied, but some error might be introduced if the knife edges did not always seat themselves in the same place, and if the bush became displaced radially from the centre of the shaft. Tests were carried out in both directions of rotation, and if the radial shift were constant, its effect was eliminated in taking the mean torque in the two directions. The shift of the knife edges between the tests could not be corrected for, but in the present tests it did not appear to be pronounced. However, the very low coefficients of friction obtained cannot be considered exact determinations since a very small error from this cause would make a large percentage alteration in the quantity μ. The error may easily amount to .001in. and since values of μ between .002 and .003 have been found, they may be 30 to 50 per cent. too low. It does not seem probable that they can be too high.

Bearing Surfaces.

In the dead load test on the first machine, the bearing surface consisted of four rings, each ½in. wide. The shaft diameter was 2in., so that the projected area was 4 square inches.

In the last series of tests in the lever-loaded machine, the axial length of metal in the bush was 1.82in. and the diameter 2in., so that the projected area was 3.64 square inches.

Lubrication.

The plummer blocks for the dead load tests were provided with a central pocket and oil ring, but this arrangement was found to be unsatisfactory, and small pipes were put in to feed the oil to the underside of the bushes under a head of about 4in. These pipes were kept filled with oil, but the lubrication still being irregular, two spiral oil grooves were cut in each ring of bearing metal. It was, however, found necessary to keep continuously oiling and to oscillate the frame axially to obtain any approach to steady running under reasonably high loads.

In the lever-loaded machine, the oil was supplied to the underside of the bearing by means of the displacement ram, and no oil grooves were found to be necessary. It is to be noted that the underside in each case was the surface free from pressure, the film of oil being carried round to the pressure side by the shaft or journal. In both cases the bore of the bush was .004in. larger than the diameter of the shaft. A preliminary set of observations was made and it was found that the rings were becoming detached from the gun-metal lining. They were therefore run in again with the addition of holes drilled through the gun-metal containers, in order to obtain a more efficient hold. The results obtained before this second running are not reported.

Summary of Observations.

Speed, r.p.m.	Load, lb.	Load per sq. in., lb.	μ
125	962	240	.012*
340	962	240	.008*
700	962	240	.014*
950	962	240	.005†
1100	962	240	.007†
2200	962	240	.010†
1100	283	71	.015†
2000	283	71	.011†

Total revolutions under 962 lb. load = 1,095,000
Total revolutions under 283 lb. load = 456,700
1,551,700

* No oil grooves.
† With two oil grooves $^1/_{16}$in. deep in each ring.

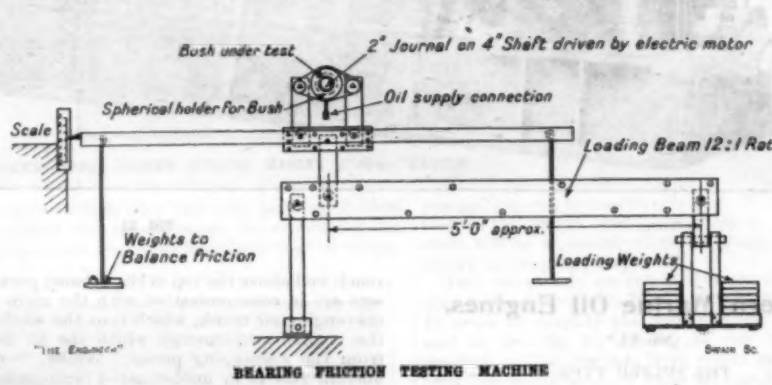
The bearing was then run at 500 revolutions per minute and loaded with 1992 lb., equivalent to 498 lb. per square inch, but the metal flowed and, filling up the oil grooves, prevented proper lubrication. The metal did not melt out, but the tests were discontinued owing to the seizing of the shaft.

Summary of Tests on Lever Machine.

Speed, r.p.m.	Load, lb.	Load per sq. in., lb.	Oil flow, oz. per min.	Temperature, deg. F.	μ
1400	890	244	.33	—	.0061
1400	1560	428	.31	171	.0037
1400	1560	428	.35	155	.0045
1400	2160	593	.34	187	.0043
1400	2160	593	.35	181	.0036
1400	2760	758	.35	193	.0037
1400	3360	923	.36	200	.0023
1400	3960	1088	.36	193	.0021
1400	3960	1088	.35	199	.0023
1400	2160	593	.35	178	.0032

The figures given for the temperatures are the mean temperatures after running about one hour in each direction. There was a slight sign of marking on the metal after the fourth test, but on repeating it the coefficient of friction fell and the marking disappeared.

The bearing was in perfect order at the end of the test, having made 1,405,700 revolutions, and the white metal showed no signs of flowing. The difference between the diameter of bush and bearing when measured was found to be slightly less than .004in., so that no wear had taken place.



BEARING FRICTION TESTING MACHINE

Conclusions.

From these tests it appears that for loading up to 250 lb. per square inch without force feed lubrication, this metal gives as good results as is to be expected from such bearings, but with heavier loads, seizing may occur. The metal may become very hot without running out, for at the end of the first series of tests the temperature estimated from the colouring of the shaft must have been locally as high as 700 deg. Fah. Under forced lubrication, the metal has given extraordinarily good results as regards friction, and even with a load of over 1000 lb. per square inch, shows no signs of wear or flow, although the temperature rose to 200 deg. Fah. The oil used in the tests was Vacuum Mobiloil B.B., a moderately heavy motor engine oil. This oil would probably give best running at 200 to 220 deg. Fah.

The above results refer to bearings in which the metal is run in from a ladle. It is possible that die cast bearings of the same metal would give still higher safe running loads. In the first series of tests, if the bearing surface had been larger and the speed lower, the lubrication difficulty would not have been so marked, and much higher loading should have been possible.

Cutting cast iron with the ordinary cutting blow-pipe cannot be done with very good results. It is, however, possible, according to *Autogenous Welding*, to cut cast iron after a fashion by producing oxidation and fusion at the same time by using iron as a combustible and oxygen to support the combustion. To do this an ¼in. extra strong iron pipe, 6ft. or so long, can be used, after having been filled with three or four pieces of No. 10 or No. 12 iron wire. This pipe is connected by a rubber tubing to an oxygen regulator, of which the pressure should be regulated to about 225 lb., which is required to start the operation. This pressure may later be reduced. To start, heat up to red the surface of the piece of cast iron to be cut, and also the end of the iron pipe. This can be done with the welding blow-pipe. Apply the end of the pipe to the hot part of the cast iron and open quickly the oxygen valve. The burning of the cast iron piece and of the end of the iron pipe takes place slowly at the start, then increases rapidly. As it burns the iron pipe is pushed in while the molten metal and oxide escape by the slot

1250 B.H.P. SULZER TWO-CYCLE MARINE DIESEL ENGINE

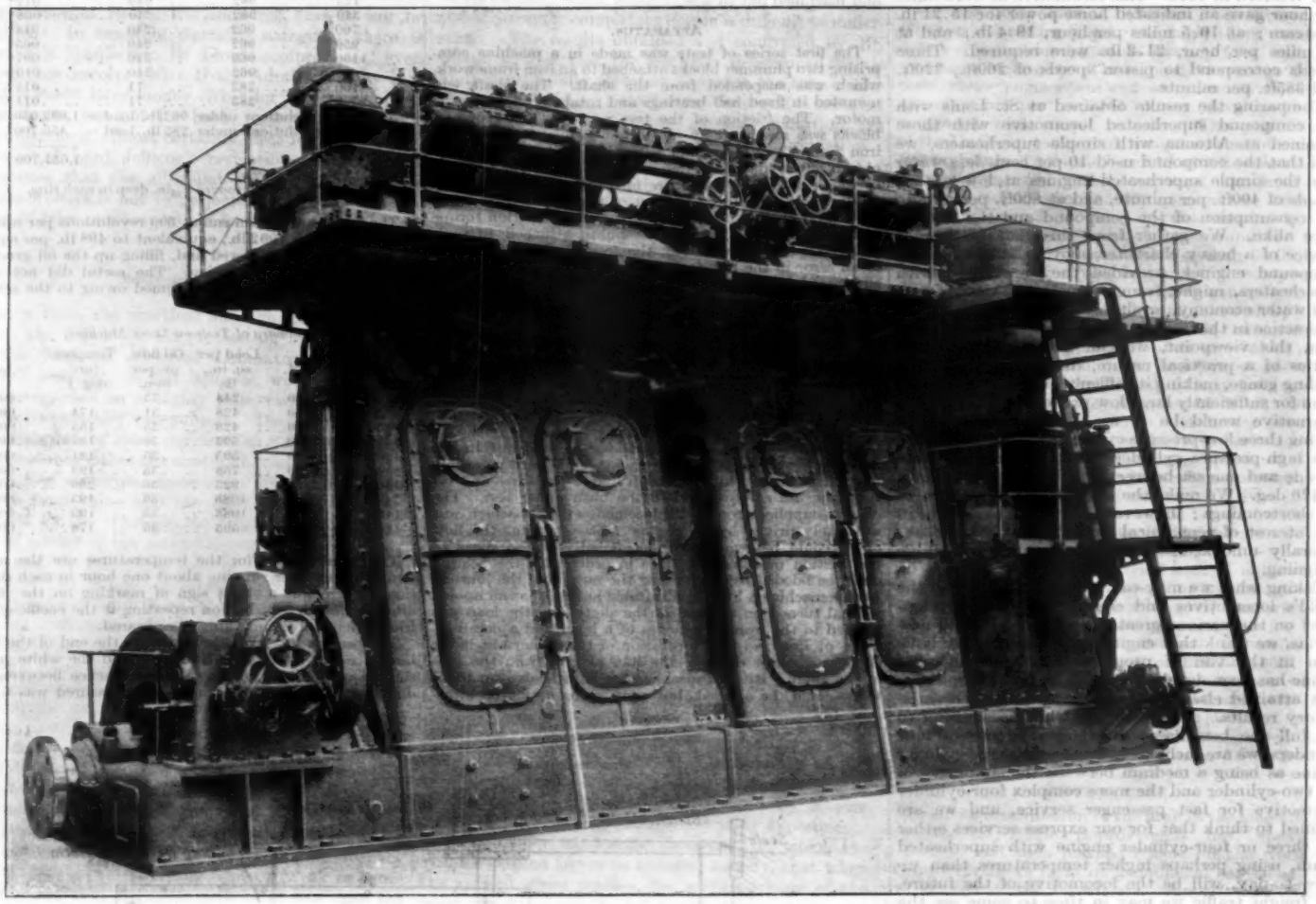


FIG. 21

Modern Marine Oil Engines.

No. VI.*

THE SULZER TYPE.

It is not desired in this series of articles to discuss the relative merits of two-cycle and four-cycle marine Diesel engines, but it is a point not without its interest that there are in this country more builders engaged upon the construction of the two-cycle than of the four-cycle type, in spite of the far greater experience and success which have been attained with the latter. Recent developments have shown that the comparative failures of the early two-cycle marine Diesel engines, built some years ago, were not due to inherent defects in the principles involved, but were the results of unsatisfactory, yet remediable features of designs. It is now agreed almost universally that the valve scavenging engine is unsatisfactory for marine work, and it is significant that in the four leading types of two-cycle motor—the Sulzer, Doxford, Camellaird-Fullagar, and Polar—port scavenging is employed. By this means the formation of cracks in the cylinder covers has been entirely eliminated, and that was one of the chief difficulties encountered in two-cycle marine engines before the war.

The Sulzer engine was one of the first in which port scavenging was employed, but the designers rapidly came to the conclusion that if the best results were to be achieved it was not desirable that free scavenging through ports uncovered by the piston in the course of its stroke should be adopted. In other words, although valves in the cylinder cover were to be avoided, some means of controlling the admission of the scavenging air through the ports at the bottom of the cylinders was essential. Naturally, with a single-piston engine, such as the Sulzer, it is much more difficult to obtain effective scavenging than in an opposed-piston type like the Doxford, in which the scavenging air may sweep right through the cylinder from the bottom to the top, and in which, moreover, the exhaust ports may be uncovered before the scavenging ports, thus allowing the pressure in the cylinder to drop to a very moderate figure before the scavenging air is admitted.

The manufacturers of the Sulzer engine overcame the difficulty which thus presented itself by the adoption of two rows of scavenging ports, one vertically above the other and each occupying about half the periphery of the cylinder. The top row of ports reach well above the top of the exhaust ports, and both sets are in communication with the main horizontal scavenging air trunk, which runs the whole length of the engine, and through which the air is delivered from the scavenging pump. Whilst, however, the bottom row is in unobstructed communication with the scavenging trunk and allows air to enter the cylinders as the ports are uncovered by the piston, admission of air through the top row of ports is controlled that no scavenging air enters through the upper row of ports until the piston has nearly reached the bottom of its stroke. In the meantime the exhaust ports have been uncovered, the pressure in the cylinder has fallen, and the admission of scavenging air through the bottom row of exhaust ports has commenced. After the piston has covered the exhaust port on its upward compression stroke the upper set of scavenging ports remains open.

FIG. 22—CAM SHAFT AND VALVE OPERATING MECHANISM OF A SULZER DIESEL ENGINE

trolled by means of a rotary valve within the scavenging trunk. These rotary valves—there is one for each cylinder—are operated from a common shaft deriving its motion from a vertical shaft at the after end of the motor, which drives the cam shaft at the top of the engine. The pressure of scavenging air is low—under 2 lb. per square inch—so that there is no trouble in maintaining the tightness of the valves, which might be a difficulty were the pressures higher.

The result achieved by this arrangement is easily understood. The operation of the valves is so controlled and as scavenging air continues to enter the cylinder a very efficient supply is ensured. The claim that this system conduces to low fuel consumption appears to be borne out by official tests, for, as will be seen later, as low a figure as 0.418 lb. per brake horse-power hour is attained with a 1250 brake horse-power engine driving its own auxiliary pumps. This is very little in excess of the consumption with normal four-cycle engine design. It is worthy of note in this connection that the Ansaldo San Giorgio Company, of Turin, which is also building two-cycle

* No. V. appeared August 5th.

marine engines with port scavenging, prefers to control the admission of the whole of the scavenging air and to have only one series of ports for its admission.

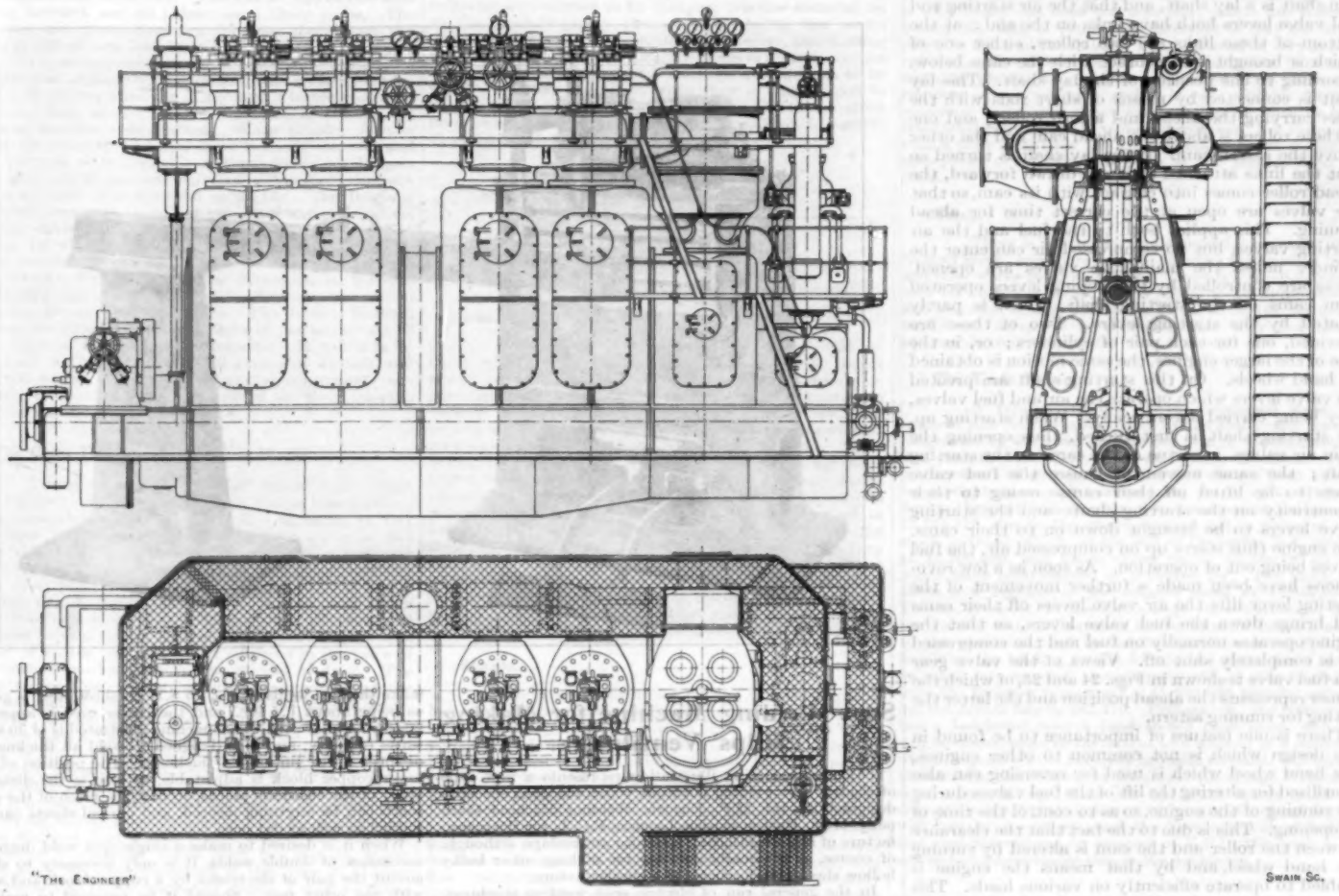


FIG. 23—1250 BRAKE HORSE-POWER SULZER MARINE DIESEL ENGINE

In all of the engines that have been described, except the Doxford type, some form of construction embodying the use of vertical tie-rods for taking the cylinder stresses has been employed. It is a curious fact that, although this arrangement was to be found in Sulzer marine engines which were built seven or eight years ago, the practice has been discontinued in the latest engines, and the cylinders are carried on a heavy cast iron frame, which is divided into two sections, each supporting two cylinders. In the 1250 brake horse-power engine illustrated in Figs. 21 and 23 the cylinders have a diameter of 600 mm. and a stroke of 1060 mm. The power is developed at about 100 revolutions per minute. It would be interesting to know why some builders such as Burmeister and Wain have reverted to the use of steel columns, whilst others, including Sulzers, have abandoned them after having given the system a fair trial. The only conclusion one can arrive at in the absence of any information is that there is no very great advantage of the one method over the other, although it would appear that the steel tie-rod construction must inevitably tend towards a lighter engine.

The Sulzer engine does not conform to normal practice in the arrangement of auxiliary plant. In addition to the double-acting scavenging pump and the three-stage injection air compressor which are driven off an extension of the crank shaft, the engine drives its own cooling water and lubricating oil pumps, in addition to a bilge pump. In spite of this a mechanical efficiency of 73 per cent. is attained, which is high in view of the fact that the scavenging pump alone must absorb nearly 10 per cent. of the total power. It may here be noted, however, that in the larger engines which they are now building Sulzers have modified the arrangement, by separating the scavenging pump from the main engine, and adopting a new type of turbo scavenging pump driven by an electric motor. The advantage of this system is that the supply of scavenging air is independent of the speed of the engine, whilst a larger shaft horse-power can be developed for a given size of cylinder.

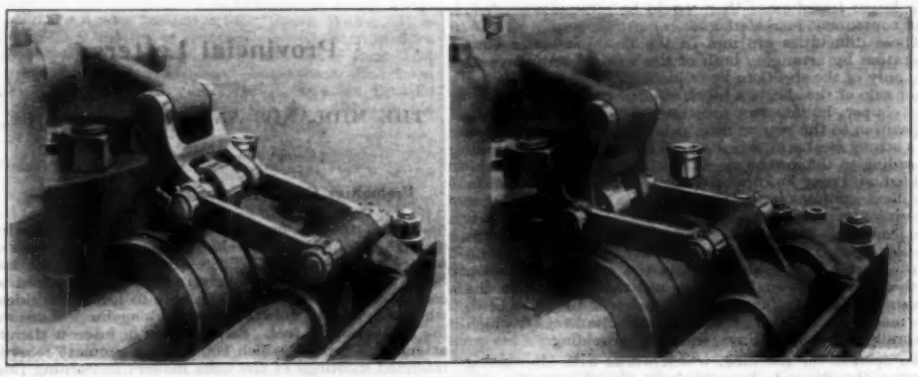


FIG. 24 AND 25—FUEL VALVE GEAR IN AHEAD AND ASTERN POSITIONS

It is well known that it is desirable to be able to supplement the supply of scavenging air under certain conditions, and with the employment of turbo scavenge pumps that can be readily effected. It is not unlikely that in the future, and particularly in large engines, there will be a general adoption of separately driven rotary scavenging pumps.

Two valves only are required in the cylinder cover, they being for the admission of fuel and starting air. In order to simplify the design of the cylinder head and to provide for cooling in the most effective manner, so that freedom from cracks may be guaranteed, the manufacturers have arranged the fuel inlet and starting air valves in one cage, so that only one hole has to be bored in the cylinder cover itself. The cylinder liner is separate from the cover, and the cylinder construction is thus reduced to its simplest form, both from the manufacturing and operating points of view. It will be noted in the illustrations that the control station for the engine is arranged at the upper platform; that is to say, at the top of the engine-room. This represents an original idea with the object of avoiding the long levers, coupling-rods, &c., which are necessary when the control is at the engine-room floor level. A good deal of the gear of a Diesel engine is at the top, so that although it is doubtful whether it will meet with the approval of the average sea-going engineer, the arrangement possesses some advantages.

There are only two valves to operate in each cylinder cover and the problems involved in devising a satisfactory reversing system have not been very difficult.

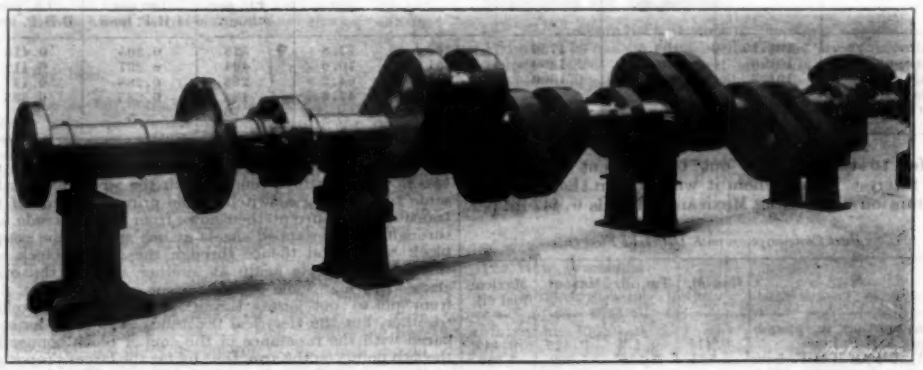


FIG. 26—CRANK SHAFT OF A 1250 B.H.P. SULZER DIESEL ENGINE

On the cam shaft are the usual two side-by-side cams for the operation of the fuel and air starting valves, these cams being set for ahead and astern running

respectively. Referring to Fig. 22, which shows a top view of a 400 horse-power Sulzer engine—in which, however, the valve system is exactly the same as in the larger set—it will be noted that in front of the cam shaft is a lay shaft, and that the air starting and fuel valve levers both have links on the end; at the bottom of these links are two rollers, either one of which is brought into contact with the cams below, according to the position of the lay shaft. This lay shaft is connected by means of short rods with the links carrying the ahead and astern rollers, and one of these rollers is above the ahead cam and the other above the astern cam. If the lay shaft is turned so that the links attached to it are drawn forward, the ahead roller comes into contact with its cam, so that the valves are open at the correct time for ahead running. This applies both to the fuel and the air starting valves, but no compressed air can enter the cylinder unless the main stop valves are opened. These are controlled by the sloping levers operated from cams on the starting shaft, which is partly rotated by the starting levers. Two of these are provided, one for each pair of cylinders; or, in the case of the larger engines, the same motion is obtained by hand wheels. On this starting shaft are pivoted the valve levers which operate the air and fuel valves, they being carried excentrically. When starting up, the starting shaft is first turned, thus opening the main air valves, in virtue of the cams on the starting shaft; the same movement causes the fuel valve levers to be lifted off their cams—owing to their excentricity on the starting shaft—and the starting valve levers to be brought down on to their cams. The engine thus starts up on compressed air, the fuel valves being out of operation. As soon as a few revolutions have been made a further movement of the starting lever lifts the air valve levers off their cams and brings down the fuel valve levers, so that the engine operates normally on fuel and the compressed air is completely shut off. Views of the valve gear of a fuel valve is shown in Figs. 24 and 25, of which the former represents the ahead position and the latter the setting for running astern.

There is one feature of importance to be found in this design which is not common to other engines. The hand wheel which is used for reversing can also be utilised for altering the lift of the fuel valves during the running of the engine, so as to control the time of its opening. This is due to the fact that the clearance between the roller and the cam is altered by turning the hand wheel, and by that means the engine is enabled to operate efficiently on various loads. This is more important for the reason that it allows perfect combustion when manœuvring and starting than from any question of fuel economy, for it permits of a considerable degree of flexibility, and a 1250 horse-power engine with a normal speed of 100 revolutions per minute will, it is claimed, operate continuously at 25 revolutions per minute. It will have been remarked that no servo-motor is used in the Sulzer engine for operating the reversing gear even in the large types. The time of opening of the valves controlling the admission of scavenging air has to be varied when reversing, and that is effected by means of a loose excentric which automatically puts the valves in the correct position. The crank shaft of a 1250 brake horse-power engine is illustrated in Fig. 26.

The Sulzer engine has a particular interest for English engineers and shipowners, since its construction has now been actively taken up by four prominent marine engineering firms, namely, Armstrongs, the Wallsend Slipway and Engineering Company, Denny Brothers, and Alexander Stephen and Sons. Its application to marine work is therefore likely to be extensive, and it is noteworthy in view of the discussion which is now so frequently heard concerning the possibility of a shortage of oil fuel that the manufacturers of the Sulzer Diesel motor claim that it will run satisfactorily on fuel oil such as is burnt under boilers. The figures given in the following tables refer to tests carried out on different oils and are of interest. From them it will be seen that the consumption when using Mexican fuel oil is 0.447 lb. per brake horse-power hour, against 0.418 lb. with gas oil, the thermo-dynamic efficiencies being 32 per cent. and 33 per cent. respectively.

Results of Tests of Sulzer Engines with Variable Load.

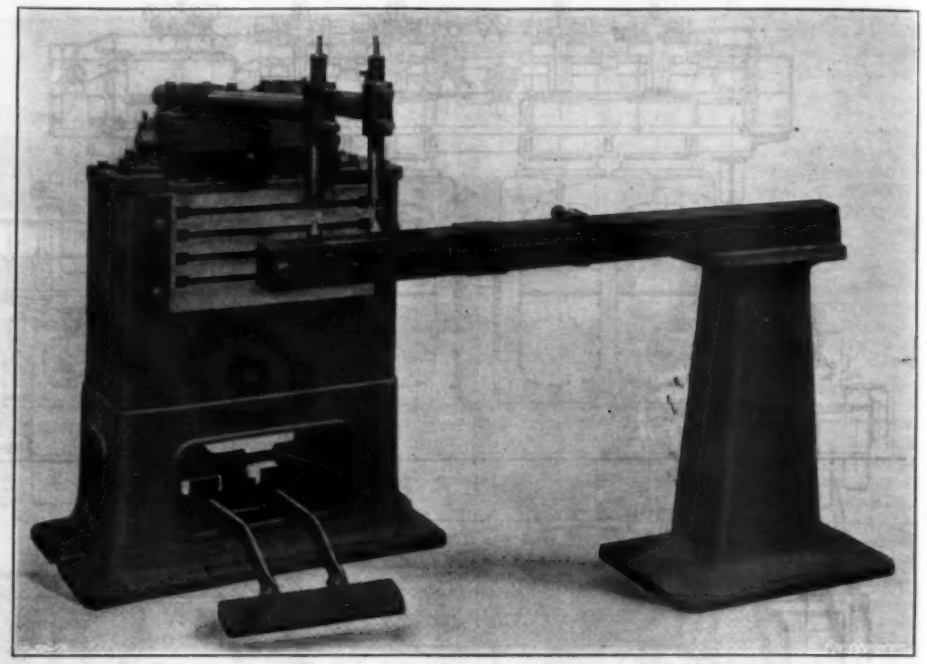
Loads.	R.P.M.	M.I.P., lb. per sq. in.	I.H.P.	B.H.P.	Efficiency, per cent.	Fuel consumption.		
						Lb. per hour.	Lb. per I.H.P. hour.	Lb. per B.H.P. hour.
Full	101.16	103.5	1736	1262	72.8	528	0.305	0.418
Three-quarters	101.6	82	1360	961	70.6	404	0.297	0.419
Half	101.3	60	1000	642	64.2	288	0.288	0.447
Quarter	101.5	40.5	678	325	47.9	193	0.285	0.595
No load	101	—	—	—	—	76	—	—

Fuel Consumption with Different Fuel Oils.

	Gas oil.	Tar oil.	Mazout.	Mexican fuel oil.
Consumption in pounds per B.H.P. hour ..	0.418	0.474	0.426	0.447
B.Th.U's per B.H.P. hour	7,524	7,536	7,500	7,820
Thermo-dynamic efficiency, per cent.	33.0	33.1	33.2	32.0

ELECTRIC SPOT WELDING MACHINE

THE M.P. ELECTRIC WELDING MACHINE CO., LONDON, ENGINEERS



Spot Welding Machine for Making Ships' Ventilators.

The accompanying illustration represents a new type of electric spot welding machine, which has been specially designed by the M.P. Electric Welding Machine Company, of 28, Hatton-garden, London, E.C. 1, for the manufacture of large ventilating cowls for steamships, although, of course, it is equally suitable for making other bulky hollow sheet metal articles of a similar nature.

In the general run of electric spot welding machines, the size of article that can be welded is limited by the length of the arms or stakes which carry the electrodes. It is found in practice that when this length exceeds, say, 36in., it is a somewhat difficult matter to construct the arms of sufficient rigidity to withstand the application of the pressure necessary to complete the weld, and, further, that the inductive drop in the arms may cause a loss of efficiency in the machine, and necessitate the use of a larger transformer than would be otherwise needed, with consequent increased cost.

These difficulties are met in the machine under consideration by arranging both of the welding arms on one side only of the sheets to be welded, and providing on the other side of the sheets a block of good conducting metal, say, copper, having two projecting points corresponding in position to the two welding arms. This block is carried on a strong steel arm, which may be of any length desired, according to the maximum dimensions of the sheets to be welded, and may be supported by a pedestal, as shown in the illustration, or it can be bolted to a wall or any other convenient part of a structure. In the machine illustrated, the length of the cantilever arm is 6ft., and its length enables sheets 12ft. wide to be spot welded by commencing in the centre, and welding first in one direction and then in the other. The makers point out that apart from the advantage of enabling very large sheets to be welded, the machine makes two spot welds simultaneously, which naturally reduces the time required for welding.

To operate the machine, which works with alternating current, the sheets to be welded are placed upon the arm in the position they are desired to occupy after welding. The foot lever is then depressed, thus bringing down the two upper arms into contact with the work, and at the same time closing a switch in the primary circuit of the transformer. Current then flows from one electrode arm through the overlapped sheets at one spot to the copper block below, and thence through the copper block and through the sheets again at another spot to the other electrode arm. Some of the current will, of course, flow from spot to spot across the sheets that are being welded together, but the electrical resistance is so high, as compared with the resistance of the copper block connecting the two points on the arm, that by far the larger proportion of the current flows through the latter. The sheets are rapidly heated to welding temperature at the spots where the electrodes touch, and by a further pressure of the pedal the current is cut off by tripping the primary switch in the transformer of the machine. The pressure on the work is maintained for a second or two while the metal cools in order to consolidate the weld. The time required to make the two welds in No. 16 S.W.G. sheet steel is given as being about 1.5 sec., and the power used is approximately 20 kilowatts. The machine illustrated is of 30 kilowatts capacity, and it is designed to weld all thicknesses of sheet up to ¼in. added thickness. The position of the lower copper block is adjustable, as also is the distance apart of the electrode points, so that the pitch of the spot welds can be anything desired, and curved sheets can be welded as well as flat ones.

When it is desired to make a single spot weld during a succession of double welds, it is only necessary to short circuit the pair of electrodes by a copper block and weld with the other pair. Should it be required to make a number of single welds, one of the upper arms is pushed back clear of the plates, leaving the other arm in the normal position for welding. The makers state that the energy required for spot welding No. 16 gauge plates amounts to about 2.5 units per 1000 welds.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Prohibitive Coke Prices and Pig Iron Situation.

The coke market continues confused, and ironmasters are proportionately disorganised. It does not matter much, however. There are no furnaces in blast in South Staffordshire, nor likely to be. Still, it would be a convenience for smelters to be able to form some idea of when they will be able to get to work again. All are waiting for a drop in fuel. Some degree of interest therefore attaches to reports which continue to circulate regarding intended meetings of the coke makers concerning prices. The smelter is constantly inquiring of the coke manufacturer as to future selling prices. Within the past week or so the coke maker has taken the initiative in trying to discover a working basis. South Yorkshire hard coke makers quote, it is understood, 32s. to 37s. 6d. at the ovens, which means 42s. to 47s. delivered in this district. These prices are much lower than ovens in several other parts of the kingdom quote. Yet smelters state that it is impossible even to pay to-day's South Yorkshire prices, some of the blast-furnace people going so far as to say that such rates for fuel would entail a loss of anything up to £2 per ton on the iron made. From the smelter's point of view, the position is made relatively worse by the very high railway rates, which add seriously to the cost of fuel. Some firms go so far as to say that the selling figure now obtainable for pig iron would barely cover the cost of fuel plus railway charges. The owners of coke ovens profess themselves very anxious to get their plant in operation. When one bears in mind the fact that it is estimated that it costs between £2000 and £3000 to restart a blast-furnace once it has been blown out, it will be readily understood that manufacturers desire to see some continuity of trade before they rekindle their furnaces. A Welsh firm which desired to get its coke ovens at work inquired from a Staffordshire smelter whether business was possible, but the best price that could be offered was £2 17s. at the ovens, which would cost the buyer something like £3 10s. before it reached his furnace. The Durham quotation is 35s. at the ovens, making the cost to buyers in South Staffordshire something like £2 10s. How the blast-furnace owners regard the situation is seen by the recent decision of the directors of an important Midlands smelting concern not to assemble again until October. Smelters continue to assert that the rekindling of their furnaces is impossible until coke can be obtained at 30s. per ton.

Idle Blast-furnaces and Belgian Foundry Iron.

The pig iron position becomes increasingly serious, so far as the manufacturing industries in South Staffordshire are concerned. There is no native raw iron coming forward, nor does there seem likely to be. The fact that not more than ten furnaces throughout the country, out of over 300, have been relighted, speaks for itself. It is understood that one furnace will recommence in North Staffordshire next week to supply certain foundry needs and the requirements of the firm's forges and mills producing best iron. None of the furnaces yet started produces for the open market. While foundry iron is scarce, it cannot be said that there is much demand, and such business as is available is being taken by Belgian firms at about £6 per ton delivered. One large contract is said to have been arranged at £5 16s. The Belgians themselves complain that their prices are unremunerative, but that values are forced down by German competition, assisted by the depreciation of the German mark. The British smelter makes no attempt to meet this kind of competition. Regrettable as the admission is, there is no denying the circumstance that Belgian competition continues to carry all before it. The lowest Midland foundry iron prices at date are £8 to £9 per ton for No. 3 and forge iron £6 to £7 at the furnaces. It will thus be seen what an immense gap still separates British and imported selling prices. Consequently, consumers, particularly of foundry iron, are getting all their supplies from the foreign source.

The Great Drop in Ironworkers' Wages.

The great drop in Midland ironworkers' wages of 80 per cent. under the Iron Trade Wages Board selling prices ascertainment, which I was able to notify in THE ENGINEER last week, in the Latest News columns, and which follows upon a reduction of 35 per cent. which came into force last June, is being talked of a great deal this week, since the reduction is little less than sensational. The drop is, of course, taken off the bonus rates which the ironworkers have been receiving since the war, and the main explanation of the reduction just announced is the fall of £5 10s. per ton, which occurred in the price of Staffordshire marked bars in the middle of June. The quotation for this class of best iron was reduced at the date just named from £27 10s. to £22, the largest reduction ever recorded in the history of the trade. Since then there has been a further drop of £2 per ton, but this last decline is not taken into account in arriving at the new wages scale just announced, since it was an event so recent as the middle of last month. As indicating how rapid the fall in manufactured iron prices has been, I may state that the average selling price, as certified by the accountants of the Midland Iron Trade Wages Board who examine the selected ironmasters' books every two months, shows a drop since the commencement of this year of £13 per ton. Returning to the matter of wages, I may add that the total percentage increase over the base rate paid to puddlers and other ironworks labour in Staffordshire and the surrounding iron districts, during part of and since the war period, was 265 per cent. Since January this figure has been reduced, including the 80 per cent. just announced, by 142½, so that the increase above the base rate of 13s. 6d. per ton for puddling is 122½ per cent. The reduction just announced includes not only South Staffordshire, but ironworkers in Lancashire, South Yorkshire, and, to a very limited extent, South Wales. It is interesting as a matter of comparison with Staffordshire wages that the wages of puddlers and other forge and mill workers on the North-East Coast have just been reduced by 47½ per cent. under the Arbitration Board's findings. Since the beginning of the year, these men's wages have been reduced by 107½ per cent.

Finished Iron.

Business in finished iron still appears to be limited to the best bar houses, which are able to keep their mills in partial operation. There is no heavy business in the market, orders being strictly for urgent needs. The marked bar houses are in a fairly comfortable position as to prices, the selling price of £20 carrying a little profit. But unmarked iron selling at £16 is of very little value to the ironmaster, even if orders were forthcoming. There is a lot of nut and bolt iron still coming over at low prices, completely defeating local rolling firms in competition. Belgian bars can still be bought in the neighbourhood of £10 10s. delivered here. Galvanised sheets are easier, notwithstanding what appears to be a rather better demand, and the recent minimum of £24 has now been superseded by the figure of £22 10s. to £23 as a market minimum. It is reported that the inquiry for sheets has improved sufficiently to warrant the starting in the near future of several mills in the Tipton area, which have been idle for some considerable time.

Cheap Steel Tube Strip.

The wrought iron and steel tube makers of the Birmingham district continue to be very much favoured respecting the price at which they can buy material at date. These people are largely profiting by Belgian competition. Belgian raw steel is becoming largely used for rolling down strip in the Black Country. The local re-roller can sell steel gas strip at about £13 per ton by using Belgian slabs, thereby underselling iron material made in the district at least £4 to £6 per ton, and in some cases as much as £7 a ton, since the official quotation for Staffordshire iron tube strip is still £20 per ton. The gas tube maker has, however, benefited from this cheap foreign steel, and has greatly strengthened his position in the international market. At the same time, the effect is to keep local mills idle. Belgian steel is slightly dearer than it was at about £8 to £8 5s. per ton for ordinary mild steel billets.

Coal and the Ironmasters.

Midland ironmasters cannot, it is said, get coal for forge and mill purposes any more cheaply than before the strike. It is reported this week that one well-known Staffordshire firm of ironmasters ordered its empty boats to be brought back from the colliery as a protest against existing prices. Happily, however, fuel is undoubtedly becoming more plentiful, especially slack, which was on offer this week at 11s. per ton. In normal times, this is used for coke making, and at present certain Staffordshire collieries are reported to be dumping this fine material on to the mounds partly cleared away during the recent strike. Ironmasters hereabouts are, however, anticipating cheaper fuel before very long, for there is a large amount of coal now on the market. Collieries are thought to be rapidly reaching a position when they will be obliged to consider seriously ways and means to make their output more available for industrial consumption than is possible at present prices.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THE market here is still waiting for that improvement which is promised by the non-technical papers nearly every day. Even some leading business men, like the presidents of the Chambers of Commerce in various districts, profess to take a hopeful view, and do not seem to realise the depth of the muddle and mess into which the trades of the country have fallen. There is much to be done before any reasonable man can hope to see clearly and to anticipate the future with any degree of confidence. We are not yet through the financial troubles which the enormous drop in selling values is bound to bring in its train. Some of these—and probably the majority of them—are camouflaged at present, but they exist just the same, and will have to be cleared away before general business can be put on a sound foundation. The struggle this year, and probably during the greater part of next year, will be to get costs of production so reduced that it will be possible to find a market for our products.

Metals.

The non-ferrous metal market is still stagnant, but there is very little movement in the prices. Copper being practically on a rock-bottom basis, there is not much probability of any reduction so far as standard or refined ingot is concerned. It is said that some American refined copper has been sold at 11¼ cents per pound, which, if the exchange were normal, would be equal to £55 per ton. Very few American producers can now make refined copper to sell at this price and leave any profit, although there may be one or two who can do so. Germany still remains the most important consumer of copper in Europe, and this circumstance seems a little ominous. It probably indicates that the recovery of the German engineering industries is much more rapid than is the case elsewhere. The last returns of American copper shipments show 10,000 tons to Germany and only about 8000 tons combined total to Great Britain, France, Holland, and Japan. The demand in Great Britain now is very small, and seems to be lessening. The great discrepancies between the prices of raw metals, and the official quotations for manufactured copper and for brass tubes seem now to be attracting more attention. It is reported that where makers are free to quote in competition they fix prices very far below the official figures. It is, however, a little doubtful whether a reform in these prices would now do much to bring about a revival of demand. Sellers of scrap metals still complain very plaintively of the lack of orders. It has always been the practice of dealers to buy all the old metal which is offered to them, although they may sometimes quote very low prices; but this accumulation of stock which cannot be sold is breaking down this practice, and some dealers are now so full that they cannot well buy any more. This suggests that the selling prices of scrap copper and brass, already low, will become lower and tempt consumers to use less of the new metals and more of the old. The weakness of the market for tin is merely an indication of the very small demand which exists for the metal in this country. There is at present an ample supply for all the needs of industry, and at the same time a considerable stock in the East which is awaiting liquidation. No doubt there are a good many people who have bought tin during the last two months with a view to profiting by the advance which was confidently expected, and the delay in the upward movement is now trying the patience of these people. If the Eastern holders of tin are also seeking to reduce their commitments it may well be that further weakness will be seen. The visible supplies of tin were some 3000 tons greater at the end of July than at the end of June, but this was to be expected from the diminished consumption. Lead has remained a firm market, although confidence in the present prices is not very great. Spelter is quiet, but it is said that the demand for the galvanising trade is improving.

Foundry Iron.

The actual demand for foundry pig iron in this district is very small when compared with the normal Lancastrian demand, and this is perhaps the reason why buyers are not at all eager to take up the No. 3 iron which is now being offered by a small Derbyshire furnace which has been re-started. This iron is being offered at £8 15s. delivered, and it is possible that it might be obtained at £8 10s.; but founders in this district are now working—where they are working at all—on foreign iron which has cost them about £6 per ton; and it is clear that stern necessity has taught them how to use this iron. Foundry foremen rebel against strange pig iron; but when it is a question of that or nothing they soon overcome any little difficulties. It is said that some French foundry pig iron is now being offered at £4 5s. per ton f.o.b., which should enable it to come into this district at less than £6 even now when transport charges are inflated. Speaking generally, the blast-furnaces of the United Kingdom remain idle, and there is no prospect of getting them going again. Cleveland iron has become very scarce, but the nominal price of No. 3 is still £7 per ton on trucks. Very little interest is now taken in it here.

Finished Material.

Buyers of finished iron and steel are still standing aloof and waiting for prices to come down lower. There is a little trade in foreign material, but even though this is very cheap one does not hear that people are rushing to buy it; and, of course, the inference is that the total effective demand for finished iron and steel is very much reduced. The official prices for British-made bars and sections, plates, &c., remain unchanged, but there are rumours of concessions; and it is very difficult for the consumer to be sure about the lowest price until he has tried what can be done in various directions. For instance, such a price as £21 per ton for steel boiler-plates is clearly susceptible of modification, even at the present level of costs.

Scrap.

There is, of course, no demand for wrought iron or steel scrap, and there will not be until the finished iron and steel works get going again. There is a small demand here for cast iron scrap, but it seems to be diminishing, and although dealers still quote £6 5s. to £6 10s. for good machinery scrap, it is probable that they are more squeezable than they were.

The Trade Slump.

A typical example of the depressed state of trade in this district is furnished by the half-yearly report just issued by the great Manchester firm of warehousemen and manufacturers, Rylands and Sons, Limited. The management of this firm's affairs has always been noted for farsightedness and cautiousness, yet in spite of this, during the past half-year the firm has sustained a loss of £1,263,315, due to the unprecedented fall in value of its stock in trade, which, at the end of December last, stood at £3,300,000, and losses under heavy contracts, all of which have been cleared or provided for. The stock in trade now appears in the balance sheet at £2,642,000. Thanks, however, to the firm's large contributions in the past to the national revenue in the form of E.P.D., and to the provision that in the final settlement of E.P.D. liabilities the trading results for the last seven years may be taken into account, the company will be able to claim from the Treasury repayment of £1,200,900, thereby reducing the actual loss to £62,370. Fortunately, the company had a handsome reserve fund to fall back upon, and it will be drawn upon to the extent of a quarter of a million, which, together with £117,490 brought forward, will leave £305,000 for distribution in dividends. Although Rylands' is an extreme case, there are no doubt scores of firms engaged in the textile industry which are at present faced with similar conditions, and the Treasury will probably find that the returns on account of E.P.D. this year will amount to a formidable sum in the aggregate.

Reduced Port Charges.

Both the Manchester Ship Canal Company and the Mersey Dock Board have now decided to reduce their rates for discharging and loading vessels and for quay porterage, warehousing and storage, owing to the reduction which has taken place in dock workers' wages.

BARROW-IN-FURNESS, Thursday.

Hematites.

Although the position has not improved to any extent, there is the welcome fact that the North Lonsdale Iron Company has decided to put into blast a furnace next week. This must not be taken as a sign of coming activity, for it will be many months before trade approaches even a normal condition. The prices for coal and coke, to say nothing of labour, precludes any chance of trade on anything like a big scale. There is a report of more inquiries, but only for small parcels, and only to meet immediate and special requirements. Prices remain as they did. There is a rumour that one of the local iron ore mines may put on a few men, but inquiries elicit no confirmation of the report. Foreign ore is well stocked at the Barrow docks; hence there is not much likelihood of there being any imports in the immediate future.

Steel.

There is practically nothing being done in the steel trade in the way of production. The hoop works at Barrow are fairly active, but there is no promise of continued work. Another department in the Barrow Wire Works may start, but if it does the billets will come from France, as they did during the war. The prospect in the local steel trade is as bad as it can be at present.

Shipbuilding and Engineering.

The men are back at work at the Naval Construction Works. The continued dispute with the woodworkers is seriously holding up important contracts, and several large vessels will either have work entirely suspended on them or they will be partly completed and then sent abroad for finishing off in the cabins, &c.

SHEFFIELD.

(From our own Correspondent.)

The New Warships.

WITHOUT being unduly optimistic, it is not too much to say that the Government's definite decision regarding the long-talked-of new warships has very considerably strengthened the hopes of a speedy trade revival in this district, for ever since the signing of the Armistice the future of the armament departments, with all their exceedingly costly plant and machinery, has been the cause of great anxiety. In normal times the output of what are known as the armament firms is about equally divided between warlike and peaceful products, so that it can easily be understood that when the former came

to a sudden standstill and the latter developed a serious slump, the position of these firms was really worse than that of ordinary industrial concerns. The gravity of the situation was apparent when, some months ago, an order from Japan for a few thousand tons of armour plate and a number of heavy shells caused quite a stir in Sheffield, whilst ordinarily it would have passed almost unnoticed. Strong representations have been made from time to time in favour of a Government subsidy of some kind in order that the armour plate and heavy ordnance departments might be maintained efficiently as national assets in readiness for any emergency. Nothing came of these efforts, but if four battle-cruisers, in certain details superior to John Brown's great Hood, are to be laid down this year, and sixteen over the next four or five years, it is quite evident, whatever the patient taxpayer may think of the matter, that for the armament firms the clouds are definitely lifting. Success generally begets success, and so what we may expect to see now is the British Admiralty's contracts being accompanied, or followed up, by orders for big warship building on account of foreign Powers. Before the war Brazil, Chili and other South American countries were important customers for this sort of thing, and when financial conditions will allow of it, there is little doubt but they will become so again. Then, of course, Vickers, Browns and Armstrongs are associated in naval building work in Spain, and also, I think, in Italy and Japan, and it will be remembered, perhaps, that about half a dozen years ago Vickers and Armstrongs were concerned together in a very considerable shipbuilding and repairing project at Constantinople. This was interrupted by the war, but presumably any final settlement with Turkey will include the resumption of this concession, which was, if I remember correctly, to be financed half by Turkish and half by British interests.

What the Contracts Would Mean.

It is believed here that two of the four capital ships to be laid down will go to yards owned by Sheffield companies, though so far as the steel works of this district are concerned it would not make a very great deal of difference where the vessels were actually built, for in any case a large proportion of the heavy armour—from 20,000 to 30,000 tons probably—and ordnance and shells would be produced in Sheffield. The battleships are simply floating masses of steel, and if sixteen of them are to be constructed over the next few years the work involved in the shape of heavy and light armour and guns, turrets, gun shields, engines and machinery, pumps, refrigerating plant, and a thousand other requirements, will be enormous. There are firms in Sheffield that specialise in the construction of heating and ventilating installations for warships, as well as in the production of cooking ranges and other kitchen provision afloat, whilst the cutlery and silver trades would greatly benefit, for a ship which becomes the home of a thousand or two men requires full equipment in such things, beside continual replenishment. Then what of the machines and tools needed in the work of building and equipping the vessels? For these reasons it will be seen at once that the Government's decision to stop breaking up the Fleet and to launch out on a building programme that will maintain the Empire's prestige on the seas is putting new life into the Sheffield steel industry, and especially into the armament firms, for the latter, instead of having to find some means of transforming the whole of their output capacity into products of a peaceful character, are beginning to see the possibility, if not the probability, of a reversion to the pre-war standard of half and half.

Coal and Coke Values.

But I have been looking ahead rather than at the actual conditions prevailing. These in themselves reveal but a very slow rate of general industrial recovery. One might reasonably say a disappointing rate, and for this state of things more than one reason is given. For example, there is the fuel question. The collieries have been hard at work for a month, and coal supplies appear to be ample for almost all purposes. Indeed, there is something like a glut in some classes of fuel—small stuff, for instance—and the export department of the business is very flat. But the trouble is that prices are being maintained at a level much too high for the development of industries dependent on coal and coke. Iron furnaces are gradually getting into blast, but large numbers remain cold because the price of coke constitutes the making of iron an unprofitable business at present values, and the latter, in face of cheap foreign material, cannot be raised. There is the difficulty. Several meetings have taken place in this district, I understand, between ironmasters and coke-oven owners, with a view to discussing the practicability of a reduction in coke prices, but the conferences appear to have had little or no result so far, for the reason that coalowners' prices are being maintained. Rightly or wrongly, the opinion is spreading that we are on the verge of an appreciable fall in coal market prices, and that very fact stiffens the backs of buyers, causing them to come on to the market for as little as possible, so that they may not be caught with considerable stocks in hand when the fall comes. In the same way buyers of manufactured iron and steel are holding their hand for the present, which means that the development of trade is being retarded. Whether or not cheaper coal would actually quicken things to the extent that some seem to think is a point which can only be tested by fact; but it is certain that a very strong feeling exists that no real good will be done for general industries until cheaper fuel can be obtained, and to that end there is no doubt many consumers are deliberately slow timing, believing the absence of demand to be one of the surest means of bringing down the market.

Railway Requirements.

What, to my mind, is one of the surprising features of the trade situation is the reluctance of railway undertakings to come into the market freely for renewals. A good deal of reliance seems to be placed on orders coming from overseas, but in pre-war times the railway material departments of the large steel works here depended to an important extent on business from the home railways. Here and there some good contracts certainly are being placed from that direction, but on the whole the companies are handing out orders very sparingly, though, of course, there is not a railway system at home or abroad but is deeply in arrears with rolling stock requirements, whilst the tracks of our tramways are, many of them, in an advanced state of disrepair. Once these matters can be taken up seriously, railway and tramway steel departments will experience a boom. In this part of the country it may be said without hesitation there are now ample facilities for meeting any boom that may develop—and the sooner the better. Last week I mentioned the activities in the construction of tanks and tank wagons and locomotive boilers at the Lincoln works of Clayton and Shuttleworth and its associate company, Clayton Wagons. It now appears that the British Petroleum Company and Shell-Mex, Limited, between them have placed with Clayton Wagons orders for 100 oil tank wagons of 14 tons capacity each, similar to the contract placed recently with Craven's, of Sheffield, whilst the locomotive boilers, as I mentioned, are for India—the Madras and Southern Mahratta Railway. According to a message from Buckarest, the Roumanian Government is still sitting on the Transport Bill, instead of getting it on the Statute Book, so that the terribly dislocated railways of the country may be taken in hand, as provided for in the Bill, by a British and a French group of rolling stock and locomotive builders—the former, of course, being Cravens, Browns and Firths, of Sheffield, and Nasmyth, Wilson and Co., of Manchester, these all being associated firms.

Unemployment Decreasing.

So far as general trade in this district is concerned, one is best able to mark the progress of the recovery by noting the fall in the number of unemployed. Last week, for instance, there was a drop of over 8000, which was quite a jump forward in the rate of absorption, and clearly proves that an increasing number of works are getting moderately busy again. Makers of automobile steel are placing hopes in a trade revival as a result of the forthcoming show in London, though it can hardly be said, by the same argument, that agricultural engineers have benefited very much from the Royal and County shows. The demand for files keeps up well, and there are signs of improvement at the crucible furnaces, though not very marked ones, new business being spasmodic. It is now a long time since high-speed steel makers experienced anything like good trade, and now the new American tariffs are causing a considerable degree of perturbation, since it begins to look very much like a ban on the excellent trade Sheffield has done in the past with the States for the highest qualities of steel. Saws continue to be rather a good line, which reminds me that the reduction of bonus arranged between the men's union and the employers came into operation on Monday last, and a week earlier that relating to the edge tool, machine knife, scythe, sickle and hook trades was put into force. In both cases the reduction is 7s. per week for men, and proportionately for youths and lads.

Iron and Steel Prices.

The general revision of iron and steel prices is still being awaited, but in view of the very few blast-furnaces that have been re-lighted so far, and the fact that many have been idle for a long time now, there is a fear of something like a pig iron famine as soon as trade revives substantially. There never were in the country such enormous quantities of scrap, but that can only be safely used in its proper proportion to pig iron. A rise in steel prices is inconceivable to-day, yet that is precisely what would follow any upward movement in iron. The natural move, however, would be in the opposite direction. Swedish pig iron, it is said, has been offered here lately at almost one-half the rates prevailing a few months ago, but most likely it is another case of realising stocks in order to raise cash.

NORTH OF ENGLAND.

(From our own Correspondent.)

Little Confidence in Trade Outlook.

There is nothing in the general trade situation as yet either to encourage confidence or optimism. Business in all sections of industry is of very small dimensions, and a general opinion prevails that the effect of the slump in trade and the miners' disastrous strike will be felt for a long time to come. The current month, of course, is usually a very quiet one so far as the placing of new business is concerned, but such great inroads have been made by foreign competitors into overseas markets, which at one time were regarded as almost exclusive to British manufacturers that the outlook for the autumn is regarded as very unsatisfactory. Great leeway has to be made up ere British manufacturers can expect to compete on a basis of cost equality with competitors on the Continent. The past twelve months have indicated in the most practical and obvious way how coal and iron may be obtained from sources other than those of the United Kingdom when the situation demands. With regard to pig iron, which is the basis of steel products, an interesting comparison of British and continental prices has recently been made by Mr. Clarence D. Smith, chairman of the Consett Iron Company. He pointed out that at present the average selling price of pig iron in this country was £7 per ton, whereas imported pig iron, delivered in the Tyne free, cost only £4 10s. per ton. Thus, unless costs are drastically reduced, the British manufacturers cannot hope to book orders in face of such competition.

Cleveland Iron Trade.

The state of the Cleveland pig iron trade just now is deplorable. The few furnaces in blast are merely producing to keep the steel works going, available stocks of iron ore are all but exhausted, and not only is the export trade in a state of suspended animation, but we are actually importing iron from abroad at a cheaper rate than the home product can be delivered. The one grain of consolation is to be found in the fact that coke prices are dropping, but they will have to fall considerably more before pig iron can be produced at competitive rates, for Luxembourg iron is reported to be coming into the Tyne at £4 10s. per ton. Figures as low as 35s. and 37s. 6d. per ton at the ovens—or from 40s. to 42s. 6d. delivered at the works—are now mentioned for blast-furnace coke, and although there is no actual business to fix prices, these quotations represent a further substantial saving in the cost of pig iron production. It is reported that in addition to the nine furnaces now in operation two more furnaces are about to be blown in on hematite pig iron. Cleveland foundry iron is still very scarce, and for prompt delivery 140s. is quoted for No. 3 for home use, and 145s. for export. Forward business, however, is possible at 5s. below these prices. The lower grades are plentiful and values unchanged.

Hematite Pig Iron.

It would appear that some of the hematite pig iron makers have sold very heavily, and it is thought that if there were any pressing calls for delivery on a substantial scale it would involve the immediate blowing in of more furnaces. At the moment, however, there is no indication of any heavy calls, and there is plenty of East Coast hematite mixed numbers on offer at 160s. for home consumption and 140s. for export.

Manufactured Iron and Steel.

With ample supplies of fuel now available, most of the steel works on the North-east Coast are now in operation again, but the extent of their activities varies according to the condition of the order books. Some are working to full capacity, others to only a limited extent; whilst in one or two cases the plant is still idle. It cannot, unfortunately, be said that the prospects are any brighter. Recent price cuts have not stimulated business, and buyers evidently anticipate further reductions, as they are only placing orders of a hand-to-mouth character. The demand from abroad, particularly the Far East, is rather better, but foreign competition is still very keen. The only change in prices this week is a decline in quotations for galvanised corrugated sheets, 24in. gauge, which, in the absence of any substantial demand, have fallen to £21 10s., and black sheets to £17 10s.

The Coal Trade.

The Northern coal trade is extremely dull and void of movement, and there is a steadily declining tendency in values. The lack of trade is increasingly pronounced, and many pits areon the verge of starvation for want of early trade. Production has reached formidable dimensions, but the ruling high prices check any development in the export trade and severely curtail the home consumption. The result is that the output is above the general demand, and colliery owners are faced with the dilemma of laying pits idle or encouraging trade by accepting substantially reduced prices. The position for all August and further ahead is weak and decidedly unsatisfactory, and so far as can be seen at the moment it would appear that the bottom has not yet been reached. The demand for the home market is only poor and spasmodic; while in the case of continental business the quotations, when they are forwarded, are turned down almost invariably, which is evidence that the present range of values is not sufficiently low to attract buyers on a large scale. In the opinion of those best able to judge, there is small hope of re-capturing our lost export trade until there is a further considerable cut in prices. As regards best Northumberland steams, the inquiry has fallen very flat, and large quantities are offered at substantial concessions, but without success. Gas coals, too, are very flat, and though there is a diversity of ideas respecting values among the collieries, there is no difficulty in procuring any quantity at very much lower figures than have recently prevailed. The bunker market has also deteriorated in common with other branches of the trade, and a variety of figures, from 30s. upwards, are indicated, according to class.

Wages and Prices on Down Grade.

Wages and prices in the iron and steel trade of the North continue to be subjected to a drastic cutting down process. Only recently a substantial cut was made in the wages of blast-furnacemen, and now, as the outcome of an ascertainment issued by the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trade of the North of England, a reduction of 47½ per cent. is made in the wages of puddlers and other forge and mill workers. The accountants state that for the two months ended June 30th, the average net selling price per ton of manufactured iron was £19 3s. 8.19d., as against £24 1s. 1.48d. for the previous two months, thus showing a decrease in average prices per ton of nearly £5. During the two months the sales totalled only 255 tons as compared with 2771 tons during March and April. These statistics provide striking evidence of the effect of recent happenings in the industrial world. The average net selling price of bars was £19 3s. 5.33d., while £19 17s. 0.72d. was paid for angles, the respective prices for the previous two months being £24 1s. 3.06d. and £23 7s. 0.77d. per ton. Since the beginning of the year the wages of puddlers and forge and mill workers have been reduced by 102½ per cent., but they are still 122½ per cent. above the standard.

Cleveland Miners Accept Wages Reduction.

With a view to getting the mines re-started, a temporary wage settlement has been reached in the Cleveland ironstone industry. Recently the owners made an offer to the miners' representatives to pay the men the present base rate plus 123.7 per cent., with a minimum of 8s. per day for datal labour. Before giving a decision on the matter the men's representatives agreed that the members of their Association should be consulted. Since that time all the lodges have been visited by the officials, and the terms of the offer explained to the miners. As a result, they have accepted the owners' offer. The new terms will be operative for three months. The rates of pay under the new agreement represent a drastic reduction on the wages paid at the beginning of the year. Before this

fresh offer was made the miners had accepted this year decreases amounting to 5s. per day. Work has been resumed at several mines this week, and the owners hope to put other mines into operation in the near future.

SCOTLAND.

(From our own Correspondent.)

Dull Markets.

The longed-for improvement in industrial circles seems very little nearer. The prolonged coal strike and continued strife in other industries still have their effect, and prospects of a general return to normal activities are dim. Consumers and producers everywhere seem determined to lie low until costs are regulated to their satisfaction, and such a consummation involves drastic alterations in working costs in all trades. The process of reducing wages is evidently bound to be a tedious one, and the worker appears to be determined to retard the inevitable as long as possible. It is obvious to everyone that falling freights and the continued inflow of cheap foreign material demand a corresponding fall in home prices. Trade in this country is already reduced to almost a negligible quantity, and the hopelessness of maintaining a high standard of wages needs no explanation. The present position of the coal trade and of the markets depending thereon provides ample evidence. Since the resumption at the mines the demand for fuel has been altogether insignificant compared with the output, and in some instances the pits have had to reduce their activities. Dear fuel prohibits a re-start at the pig iron foundries, restricts the operations at the steel and iron works, and interferes with production in general. Then, again, the strike of the shipyard joiners has had its own particular effect on that industry, and, in conjunction with other adverse conditions, has reduced activities to an enormous extent. It is hoped that the next two or three weeks will see a move in the right direction. Cheaper fuel is promised, and there are hopes of a settlement at the shipyards. In the meantime the various markets are almost without movement.

Another "Movement" Amongst Scotch Miners.

It is reported that a new trades union organisation has been formed under the designation of the Scottish National Trade Union Association. Under its auspices a meeting was held last week-end and new members were enrolled. The aims of this new union are non-political and constitutional, and the strike weapon is to be dispensed with. In the course of the meeting already mentioned, one speaker declared the belief that the union would get better terms from the employers by reasonable negotiation than the British Miners' Federation had obtained after a three months' strike. Their experience of strikes was that the leaders promised victory if a united front was maintained, while in the end these same leaders, while assuring them that the miners were the greatest fighters on earth, advised them that to fight longer would be suicidal. It was stated that the new union would be recognised by the employers immediately five hundred members were enrolled, which is expected to be accomplished within a week. A branch was accordingly opened at Holytown. All meetings of the executive council of the new union are to be opened and closed with prayer.

Steel and Iron.

There is practically nothing to add to what has already been said regarding these trades. Business is more or less at a standstill, and markets are lifeless. Some works are partially employed fulfilling old contracts, but the measure of new business is extremely light. It has been rumoured that malleable bars would be reduced to £14 immediately, but with imported bars in the region of £8 a reduction of £2 would be of little avail. Pig iron smelters are credited with the intention of making a partial re-start in an endeavour to keep their customers together, but no movement in this direction has been reported as yet.

Coal.

The coal market at present is flooded with supplies, and the demand is wholly inadequate to make any appreciable impression on accumulations. Prices have fallen, and are still dropping, but consumers are not affected thereby, and only barest necessities are being taken. Industrial orders are meagre, and house coal is moving very slowly. Export is dull in the extreme, and only a very moderate turnover in bunkers is reported. Aggregate shipments for the past week amounted to 116,400 tons against 99,995 in the preceding week, and 289,827 tons in the same week of 1913.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

It is not possible to write by any means in an optimistic vein regarding the prospects of the coal export trade over the remainder of the year. The activity which succeeded the resumption of work following the national strike rather flattered only to deceive, and it has turned out, as was feared might be the case, that this activity was based on an accumulation of pressing orders for shipment as soon as possible after our labour troubles were over, and that buyers abroad, having satisfied their most urgent needs, are postponing the placing of further business as long as they can in the full expectation that South Wales coal prices will come down. Exchange rates, as well as the depressed industrial conditions abroad, are still hampering operations, and while these are factors in the present situation, not the least important is the question of competition. This is extremely keen. There has scarcely ever been a time when prices quoted were cut so fine consistent with a fair prospect of securing the coals and tonnage requirements, and coal exporters of the pure middle-man class are going through a very trying time. Buyers abroad naturally, when placing their business, want to feel that they are getting in on the bottom floor, and they are afraid to operate for fear that before the shipment can be effected prices will have relaxed to a further appreciable extent, leaving them with comparatively dear coals to get rid of, if they have not already arranged for their disposal to actual consumers. The last fortnight has witnessed a fall in prices of large steam coals of about 10s. per ton, and it is regarded as inevitable that the next few months will see a further easing down in values until they get into the neighbourhood of 30s. to 35s. for superior large steams.

Output and Unemployment.

An additional reason for the set-back in values is the improvement in production. Undoubtedly the output has been better than was looked for. The collieries have been put into a state of repair more quickly than was expected. The miners themselves, tired of "holidays" during the strike period, are working with more will. Holidays at Bank Holiday time were for the most part limited to the Monday, whereas most people expected they would absorb the usual three days or more. Such was not the case, however, and the consequence is that coal has been coming down more freely, and the demand being unequal, prices have had to give way for prompt shipment in order that wagons could be freed and collieries enabled to keep going. As for business over the remainder of the year, those who are disposed to face the position without prejudice recognise that even present prices must be cut another 5s. per ton at least to offer buyers any encouragement at all to buy. It has to be remembered, too, that the present output is obtained with approximately 50,000 miners still idle. When these men will secure employment it is difficult to say. The miners' leaders are getting very anxious about the situation, especially as their proposal to the various lodges that a levy of 5 per cent. on earnings should be made in order to provide a fund for supporting the unemployed has been turned down. Those who are working are evidently not prepared to make such a contribution for the benefit of their less fortunate members, and the result is that the leaders are compelled more than ever to take up this question of unemployment with the coalowners, who, however, are doubtless equally indisposed to be saddled with surplus labour, which means enhanced costs.

Colliery Enginemen.

The movement for resuscitating the Colliery Enginemen, Stokers and Craftsmen's Union as a separate organisation from the Miners' Federation continues to make headway. A further meeting for delegates from the Rhondda collieries has been held at Porth, when it was reported that the progress made in securing members was very satisfactory. It was impressed upon those present that they must act quickly owing to the fact that attempts were being made by other unions to "poach" members, which, of course, will, if successful, materially affect the power of the enginemen and stokers as a class. Naturally, the miners' leaders are doing their utmost to check the disruptive movement, but it is doubtful whether their efforts will be very successful. The meeting at Porth passed a resolution advising all workmen that they should have nothing to do with any other union except those already recognised by the South Wales Coalowners' Association. A further conference to consider the question of the reconstruction of the old union was called to be held at Cardiff yesterday (Thursday).

Tin-plate Trade.

The wages of South Wales tin-plate workers, apart from adjustments in base rates, were from Monday last only 81½ per cent. above pre-war, as against the cost of living, according to the Board of Trade returns at the beginning of last month of 119 per cent. The requirements of tin-plate workers to keep themselves fit for their strenuous occupation are regarded as higher than the majority of workers, so that it will be appreciated that tin-platers are experiencing a relatively harder time than other classes of labour, and they have passed through a very long period of absolute unemployment. Altogether their condition is calculated to be worse than during the bad period of trade brought about by the McKinley tariff. Wages in the tin-plate industry are governed by a sliding scale based upon the selling price of tin bars, which are now quoted at £9 10s. per ton as against £25 to £26 during the war. Members of the Dockers' and the Welsh Artisans' Union are urging that the Joint Industrial Council should meet to consider the position.

Coal Tippers' Wages.

Negotiations have been in progress for some weeks past concerning the wages of coal tippers, and a provisional agreement has now been concluded. It is now reported that the proposal is to reduce the minimum wage to £4 per week, plus 50 per cent. of the pre-war tonnage rate on every 100 tons shipped, the latter to be decreased by 5 per cent. per month or by 25 per cent. by the end of 1921, when there will be further negotiations regarding wage alterations considered necessary. The minimum wage of tippers was £4 14s. 10d. per week, in addition to 2s. 9d. for 100 tons shipped, the latter being 50 per cent. on the pre-war tonnage rates. Tippers on an average earned approximately £5 5s. per week.

Railway Grouping.

There has been much discussion and negotiation arising out of the Railways Bill, and not a little rivalry between the various ports and interests in this district, in order to secure the best terms under the grouping scheme. According to a pledge given to Major Cope by the Great Western Railway Company, it is the intention of the latter, in the event of the Government scheme materialising, to do its utmost to work with the maximum efficiency the unified railway system which will be formed by merging the smaller lines and docks in the Great Western Company. In all matters affecting the towns and docks the Company's aim and object will be to hold the balance evenly between the various interests, and not to advance the interests of any particular port or ports to the disadvantage of others.

Current Business.

The inquiry on the steam coal market during the past week has been very limited, and stocks of coal are gradually accumulating, making many owners very apprehensive regarding the future and the regular working of their pits. The demand has fallen off substantially, while at the same time the output is above what was expected. Best Admiralty large coals are not worth more than 40s. to 41s., and dry coals are particularly dull at 37s. 6d. to 40s. Business has been done for spot supplies at even less. Monmouthshire coals are also easier, and instead of being 50s., as they were a fortnight ago, are now about 37s. 6d. to 40s. Superior smalls are obtainable at 20s., and inferior grades at 15s. Patent fuel is round about 40s. to 42s. 6d., while coke is very scarce and firm at 60s. to 65s. Pit-wood maintains 37s. 6d. to 40s. Anthracite coals keep a remarkably firm tone, and are well booked up for this month and even for a part of next. Sized coals especially are scarce, nuts being 72s. 6d. to 75s., cobbles 70s., and beans 65s., while rubbly culm rules about 22s. 6d., breaker duff at 12s. 6d. to 13s. 6d., and billy duff 9s. 6d. to 10s. 6d.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

The Fall in Coke.

The fall announced this week in hard coke prices to 30s. per ton at the ovens in South Yorkshire, Derbyshire and Nottingham is an important matter. What I have said in my letter under the head of "Coke and the Iron Trade" is necessarily modified by the more recent announcement. Smelters here note, however, that the reduction is signalled as one of 15s. a ton. This scarcely represents the position. As I have shown in my Birmingham report, prior to the reduction some of the Staffordshire ironmasters had received quotations of as low as 37s. and even 32s. per ton at the ovens. Thus the actual fall is very much less than appears on the immediate surface. It is questionable whether even the drop which has occurred will be sufficient to encourage much relighting of blast-furnaces. The smelters here have been talking of requiring to buy at certainly five-sixths, if not at two-thirds of the new official oven price. The figure at which they alone consider it would pay to recommence pig making is 25s. or 20s. per ton for hard coke at the South Yorkshire ovens. The necessary 10s. per ton additional for railway carriage would bring the figure to 35s. or 30s. per ton delivered to the South Staffordshire furnaces, and more than that smelters declare they cannot pay and see a profit on the iron. A further reduction in price at a pretty early date is therefore looked for.

Steel Works Change.

Mr. Ed. Hickman has resigned the chairmanship of Alfred Hickman, Limited, Spring Vale steel works and blast-furnaces at Bilston, near Wolverhampton, after being connected with the works for over forty-three years. He is succeeded in the chairmanship by Brigadier-General T. E. Hickman, C.B., D.S.O., the eldest surviving son of the late Sir Alfred Hickman, first baronet. At a presentation to the late chairman this week by the over 2000 workpeople, it was remarked on behalf of the firm that the recent amalgamation of Alfred Hickman, Limited, with Stewarts and Lloyds, tube makers, of Glasgow and Birmingham, was considered an opportune moment for Mr. Ed. Hickman's retirement.

SHEFFIELD.

The Derbyshire Iron Trade.

The dispute at the Staveley Ironworks, owing to which there was no resumption after the strike, has now been amicably arranged, and by the end of a fortnight three of the four blast-furnaces will be operating. One hundred out of 150 coke ovens are also to be started forthwith. There is a good deal of work on hand at the Derbyshire foundries, and a moderate inquiry for bar iron is reported. Many inquiries have been received by the Derbyshire ironmasters lately regarding various descriptions of material.

WALES AND ADJOINING COUNTIES.

Coal Prices.

Coal market conditions continue to be easy. The Cardiff and District Merchants' and Coal Factors' Association has received official intimation from the best house coal collieries that a reduction of 7s. 2d. per ton would be made in all large coals delivered on and after Wednesday, 10th inst. The public is to receive immediately the advantage of this drop.

Dock Closed.

As from Monday next the Alexandra Dock Company, Newport, has decided to discontinue the shipment of coal at its Town Dock, as a result of the continued depression in trade.

Swansea Metal Exchange.

Several more tin-plate works have resumed operations. Quotations for tin-plates are, however, down about 2s. per box basis on the week. For forward supplies the price is down to about 22s. 6d. f.o.b., and taking Welsh bars at £9 10s. per ton, it is estimated that this means a loss of about 3s. per box on the present cost of production. The galvanised sheet market displays rather an improving tendency.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	45/- to 60/-
[1] Spanish	30/-
[1] N. African	30/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	37/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—[2]		
Hematite	9 0 0	—
No. 1 Foundry	8 15 0	—
No. 3 ,,	8 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	8 0 0	7 0 0
No. 1	8 2 6	7 12 6
Cleveland—		
No. 1	—	—
Silicious Iron	—	—
No. 3 G.M.B.	6 15 0	7 0 0
No. 4 Foundry	6 15 0	7 0 0
No. 4 Forge	5 17 6	6 2 6
Mottled	5 17 6	6 2 6
White	5 15 0	6 0 0
Midlands.		
Staffs. *(All nominal).*—		
All-mine (Cold Blast)	17 0 0 to 17 7 6	
Part Mine Forge	8 0 0	
,, Foundry No. 3	9 0 0 to 9 5 0	
Northampton [3] *(All nominal).*—		
Foundry Nos. 2 and 1	8 10 0	
,, No. 3	8 0 0 to 8 5 0	
,, Forge	6 17 6	
Derbyshire [3] *(All nominal).*—		
No. 3 Foundry	8 0 0 to 8 5 0	
Forge	7 0 0	
Lincolnshire [3]—		
Basic	*Uncertain.*	
Foundry	,,	
Forge	,,	
N.W. Coast—[3]		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	8 0 0	
Special	9 0 0 to 11 0 0	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
N.E. Coast—		
Crown Bars	16 0 0	19 0 0
Best ,,	17 0 0	20 0 0
Tees	15 10 0	15 10 0
Lancs.—		
Crown Bars	16 0 0	—
Hoops	20 5 0	20 0 0
S. Yorks.—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Hoops	20 5 0	—
Midlands—		
Marked Bars (Staffs.)	20 0 0	—
Crown Bars	16 0 0	—
Nut and Bolt Bars	16 0 0	—
Black Sheets (dbls. nom.)	18 0 0 to 20 0 0	
Galv. Sheets, 24 W.G. (f.o.b. L'pool, or equal)	23 0 0 to 25 0 0	
Gas Tube Strip	20 0 0	—

STEEL.

	Home.[5] £ s. d.	Export.[6] £ s. d.
Scotland—[4]		
Boiler Plates	26 0 0	—
Ship Plates $\frac{3}{16}$in. and up	15 0 0	—
Sections	14 10 0	—
Steel Sheets $\frac{1}{16}$in. to $\frac{3}{16}$in.	16 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	24 0 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	15 0 0	14 0 0
Angles	14 10 0	13 10 0
Boiler Plates	21 0 0	21 0 0
Joists	14 10 0	13 10 0
Heavy Rails	14 0 0	—
Fish-plates	19 0 0	—
Channels	14 10 0	—
Hard Billets	13 0 0	—
Soft Billets	11 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	14 0 0	—
Light ,,	17 0 0 to 19 0 0	
Billets	13 0 0	—
Ship Plates	15 0 0	—
Boiler ,,	21 0 0	—
Manchester *(Prices irregular and uncertain, unchanged)*—		
[7] Bars (Round)	14 0 0 to 16 0 0	
[7] ,, (others)	15 0 0 to 16 10 0	
Hoops (Best)	20 5 0	20 0 0
,, (Soft Steel)	17 5 0	17 0 0
Plates	15 0 0	—
,, (Lancs. Boiler)	21 0 0	—
Sheffield *(Prices irregular and uncertain)*—		
Siemens Acid Billets	15 0 0	—
Bessemer Billets	16 10 0	—
Hard Basic	13 0 0	—
Soft ,,	12 0 0	—
Hoops	17 5 0	—
Soft Wire Rods	13 15 0	—
Midlands—		
Small Rolled Bars	12 10 0 to 14 10 0	
Soft Billets and Bars	12 0 0	—
[8] Hoops	17 0 0	—
Tube Strip	12 10 0 to 13 10 0	
Angles and Joists	14 10 0	—
Tees	15 10 0	—
Bridge and Tank Plates	15 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/- to 25/6
Block Tin (cash)	162 10 0
,, (three months)	164 10 0
Copper (cash)	70 0 0
,, (three months)	70 7 6
Spanish Lead (cash)	23 15 0
,, (three months)	23 7 6
Spelter (cash)	25 17 6
,, (three months)	26 12 6
Manchester—	
[9] Copper, Best Selected Ingots	71 10 0
[9] ,, Electrolytic	75 10 0
[9] ,, Strong Sheets	105 0 0
,, Loco Tubes	0 1 3½
Brass Loco Tubes	0 1 1½
,, Condenser	0 1 5½
Lead, English	25 0 0
,, Foreign	23 15 0

(Metal prices practically unchanged).

FERRO ALLOYS.

(All prices now nominal).

	Per Ton.	Per Unit
Tungsten Metal Powder	2/- per lb.	
Ferro Tungsten	1/6 to 1/8 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£35	12/-
,, 6 p.c. to 8 p.c. ,,	£36	12/-
,, 8 p.c. to 10 p.c. ,,	£36	12/-
,, Specially Refined		
Max. 2 p.c. carbon	£82	32/-
,, 1 p.c. ,,	£96	39/-
,, 0·75 p.c. carbon	£110	47/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/9 per lb.	
Ferro Manganese (per ton)	£18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£14 10 0 scale 6/- per unit	
,, ,, 75 p.c.	£22, scale 7/- per unit	
,, Vanadium	22/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	15/- per lb.	
Aluminium (per ton)	£115	

FUELS.[10]

	Export.
Scotland.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	33/6
,, ,, Ell	34/-
,, ,, Splint	32/6 to 35/-
,, ,, Trebles	34/6
,, ,, Doubles	32/6
,, ,, Singles	31/-
Ayrshire—	
(f.o.b. Ports)—Steam	33/6
,, ,, Splint	32/6
,, ,, Trebles	34/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	30/- to 35/-
Screened Navigation	40/-
Trebles	33/-
Doubles	31/6
Singles	30/-
Lothians—	
(f.o.b. Leith)—Best Steam	32/6
Secondary Steam	31/-
Trebles	34/-
Doubles	32/-
Singles	30/-
England.	
[10] N.W. Coast—	
Steams	45/-
Household	56/8 to 60/-
Coke	56/-
Northumberland—	
Best Steams	32/6 to 35/-
Second Steams	29/- to 30/-
Steam Smalls	13/- to 15/-
Unscreened	30/- to 35/-
Household	36/- to 40/-
Durham—	
Best Gas	35/- to 37/6
Second	30/- to 32/6
Household	36/- to 40/-
Foundry Coke	43/- to 50/-
Sheffield—[11]	
S. Yorks. Best Steam Hards	33/2 to 33/8
Derbyshire Hards	32/8 to 33/2
Seconds	31/8 to 32/2
Cobbles	31/8 to 32/2
Nuts	31/2 to 32/2
Washed Smalls	28/8 to 30/2
Best Hard Slacks	20/- to 25/-
Seconds ,,	20/- to 23/-
Soft Nutty ,,	20/- to 25/-
Pea ,,	18/- to 22/-
Small ,,	15/- to 18/-
House, Branch	40/2 to 40/8
,, Best Silkstone	36/8 to 37/2
Blast Furnace Coke	(45/-, 55/- export)
South Wales.	
Cardiff—[12]	
Steam Coals:	
Best Smokeless Large	39/- to 40/-
Second ,, ,,	37/6 to 38/6
Best Dry Large	39/- to 40/-
Ordinary Dry Large	35/- to 37/6
Best Black Vein Large	37/6 to 40/-
Western Valley ,,	37/6 to 38/6
Best Eastern Valley Large	36/6 to 37/6
Ordinary ,, ,,	35/- to 36/-
Best Steam Smalls	20/- to 21/-
Ordinary ,,	15/- to 17/6
Washed Nuts	40/- to 42/6
No. 3 Rhondda Large	40/- to 42/6
,, ,, Smalls	35/- to 37/6
No. 2 ,, Large	35/- to 37/6
,, ,, Through	30/- to 32/6
,, ,, Smalls	16/6 to 17/6
Coke (export)	60/- to 65/-
Patent Fuel	37/6 to 40/-
Pitwood (ex ship)	37/6 to 40/-
Swansea—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	55/- to 57/6
Red Vein	55/- to 57/6
Big Vein	55/- to 57/6
Machine-made Cobbles	70/- to 72/6
Nuts	72/6 to 75/-
Beans	60/- to 65/-
Peas	42/6 to 47/6
Breaker Duff	15/- to 17/6
Rubbly Culm	22/6 to 24/6
Steam Coals:	
Large	38/- to 40/-
Seconds	38/- to 38/-
Smalls	17/6 to 20/-
Cargo Through	30/- to 32/6

[1] Delivered. [2] Net Makers' works. [3] At furnaces. [4] Glasgow, Lanarkshire and Ayrshire. [5] Home Prices—All delivered Glasgow Station.
[6] Export Prices—F.O.B. Glasgow. [7] Prices represent the real market before the *official* change was made. [8] These prices are practically alike now.
[9] Sheets reduced while other prices are advancing. [10] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. [11] For inland sales. [12] Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

The Situation.

So long as industrial prosperity depends upon an improvement in the financial situation, there can be no hope of a rapid recovery, but the general state of things is, nevertheless, tending to a greater stability, which may before long exert a favourable influence upon trade and industry. All kinds of industrial enterprises are paralysed through lack of capital. So much money has been absorbed by the State loans that there is comparatively little left for other investments, and capitalists refuse to interest themselves in industrial undertakings when temporary laws are passed that considerably reduce the responsibility of defaulters. At a time when the industrial and commercial position was extremely precarious, the facilities offered to manufacturers and others in financial difficulties were necessary to save the country from an industrial collapse; but now that things are beginning to settle down, and the weaker elements are being eliminated to a large extent, it is felt that the Government should withdraw the props that have been holding up unsound concerns, and allow industry and finance to continue under normal conditions. While the law which accords special facilities to defaulters for compounding with creditors, whereby payments are extended over a considerable number of years, may have prevented the crisis from developing into a disaster, it has been taken unfair advantage of by many people, and has to a large extent encouraged reckless speculation, with the result that credit has suffered quite as much as if the law were not in operation. If the situation is to improve, all these makeshift expedients must be suppressed. The fact of their being employed conveys an impression that the situation is worse than it really is. On the contrary, there are many things pointing to a gradual re-organisation of finance.

The Eight Hours' Day.

While the manufacturing industries are labouring under the disabilities of the financial situation, they can scarcely be expected to undergo a rapid and general recovery until they are relieved of some of the burdens imposed upon them by the labour legislation immediately after the Armistice. When those laws were enforced, it was understood that they would constitute part of an international legislation, and while the eight-hours' day was applied throughout the country in the belief that it would become general in all allied countries, it has failed to better the situation of the men as a class, and has proved disastrous to many branches of industry. The French merchant marine is the only one in which the eight hours' day is enforced. It has imposed burdens upon shipowners that are particularly heavy at a time when freights are so low, and while the shipowners are helpless against the strong opposition of the seamen's union, it is felt that something must be done to modify a law that stands in the way of shipowners successfully meeting foreign competition. The eight hours' day is specially threatened by the experience of the railways, for on the State system it was found necessary to increase the number of hands by 150,000, and as there was a falling off in individual efficiency, the losses upon working have been increasing at an alarming rate. The same thing is observable in the other State administrations. The Government early found it necessary to suppress the eight hours' day in the agricultural industry, and it is now probably one of the strongest opponents of a measure of which it was at one time the most strenuous advocate. In the manufacturing industries it is found that while in some branches the eight hours' day is giving good results, in others it is quite inapplicable. Consequently, the Government has announced its intention of appealing to Parliament for a modification of the law in the sense of applying it only to those industries that will not suffer from its adoption.

Power Alcohol.

The question of power alcohol has been raised again this week by a report presented to the Senate by M. Maurice Sarraut. According to this report, the idea of the Government in instituting a monopoly is to prevent speculation and ensure stability of prices, at the same time developing production and thereby producing at home the 8,000,000 hectolitres of alcohol that are at present purchased abroad every year. It is proposed to sell alcohol to consumers for industrial purposes at prime cost, while, if necessary, the Government is prepared to sell alcohol to power users at a loss, the difference being eventually made up for by a larger and cheaper production, and by higher taxes upon alcohol for export. The successful working of the monopoly evidently depends upon abundant and cheap supplies of alcohol for industrial purposes, but it is far from meeting with the approval of distillers, many of whom find that the production of alcohol at the prices fixed by the State is not sufficiently remunerative.

Turbo-Compressor.

At the Congress for the Advancement of Sciences held at Rouen during the past week, M. A. Rateau gave further particulars of his turbo-compressor as applied to aeroplanes which he brought out in an experimental form four years ago, and has since permitted of airmen attaining far greater altitudes than were previously possible. As the weight of air diminishes one half at an altitude of 5400 m., M. Rateau attempted to double the pressure of the air to the engine by means of a turbine actuated by the exhaust and driving a fan having a diameter of 24 cm. He found that this required a speed of 30,000 revolutions per minute, which was found to be quite impracticable. The fan blades became red hot. He was able to overcome these difficulties with an improved apparatus which he declares is identically the same as that employed in the United States in February, 1920, for the record of 10,000 m. M. Rateau believes that it will be possible to make apparatus which will permit of aeroplanes flying at an altitude of 6000 m. and at a speed of 400 kiloms. an hour.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

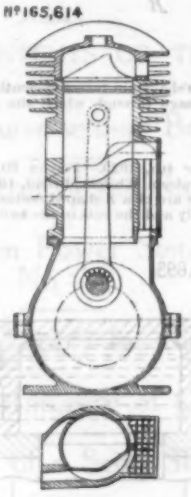
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

165,614. May 8th, 1920.—Two-stroke Engine, The Birmingham Small Arms Company, Limited, and R. H. Pearsall, Small Heath, Birmingham.

This invention concerns the transfer passage used in two-stroke engines to convey the compressed air and charge from the crank case to the cylinder. The carburetted charge is drawn into

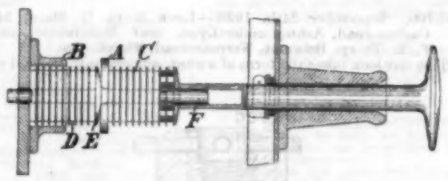


the crank case, while plain air, which is used to scavenge the cylinder, is drawn into the transfer passage. In order to check turbulence in the transfer passage and thus minimise the loss of combustible, the passage is subdivided in honeycomb fashion as shown in the plan view.—*July 7th*, 1921.

TRAMWAYS AND RAILWAYS.

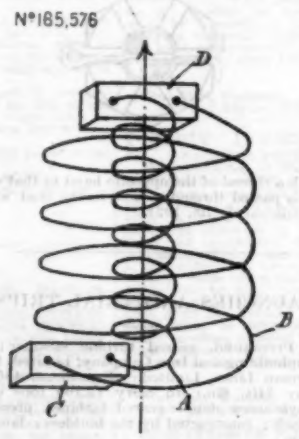
165,611. May 7th, 1920.—Buffing Gear, G. Spencer, Moulton and Co., Limited, 77–79, Cannon-street, London, E.C. 4, and F. C. Cook.

In this buffing gear two springs are provided for each buffer and are so arranged that during the early part of their compression they act in tandem; when, however, they have been compressed to a certain extent the load is shared between the two springs. In the latter condition the plate A bears on the top of the sleeve B and forms an abutment for the spring C, while the spring D is compressed by the flange E on the spindle F, which buts against the bottom of the hole in the buffer stalk. The operation during the early stages of compression is obvious. —*July 7th*, 1921.



WIRELESS TELEGRAPHY.

165,576. April 15th, 1920.—Improvements in Inductance or Reactance Coils, Alfred Richard Taylor, of 49, Idmiston-road, West Norwood, London, S.E. 27.

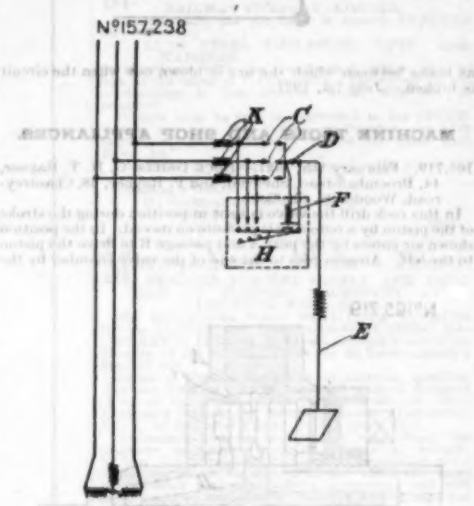


Two coils A, B are arranged about a common axis and having the two adjacent ends of each connected to a support C and the other two adjacent ends of each connected to a support D so that by moving D away from C along the common axis of the two coils they may be extended together. The arrangement is especially suitable for use in wireless receiving apparatus in which there is reactance between two circuits, as the inductance and capacity of the receiving coil may be readily varied without affecting the coupling between that coil and the reaction coil.—*July 7th*, 1921.

TRANSMISSION OF POWER.

157,238. August 9th, 1919.—An Improved Electric Arrester, Hermann Peter Bendmann, of Wehrheimerstrasse 3, Frankfurt a/Main, Germany.

The lightning arrester described in this specification is arranged for discharging excess pressures in a polyphase alternating-current system. On the occurrence of an excess voltage in any of the phases, there is a spark discharge at the corresponding spark gap C. Since the resistance D is greater than that of electro-magnet coil F, the greater part of the capacity

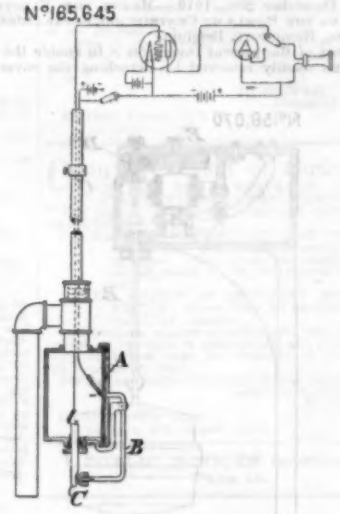


current or the supply current following the spark discharge passes through the coil F, which causes the magnet to pull up the switch arm H. All the spark gaps are therefore connected to the earthed lead E and are short-circuited with one another. Hence the discharge arc at the spark gap is extinguished and no more current passes through the coil F. Thereupon the magnet releases the switch H which disconnects the earth conductor E from the high-pressure side of the spark gap. It is preferable to immerse the switch in oil. Resistances are connected at K.—*July 7th*, 1921.

MEASURING AND TESTING INSTRUMENTS.

165,645. June 8th, 1920.—Sound Detecting Apparatus, W. L. Walker, 1790, Broadway, New York.

It is claimed for this apparatus for detecting submarine sounds that it is sensitive over a wider range than is usual. The sound box is provided with a diaphragm A, to the centre of which is affixed a bell-crank lever B. The opposite end of this lever



approaches a rod C protruding from, but insulated from, the sound box. The lever and the rod form the two terminals of an electric circuit including an amplifier and a telephone. The chief peculiarity in the apparatus lies in the use of two dissimilar metals for the contact parts of the lever B and rod C, so that, in conjunction with the salt water, they may produce a current in the telephone circuit.—*July 7th*, 1921.

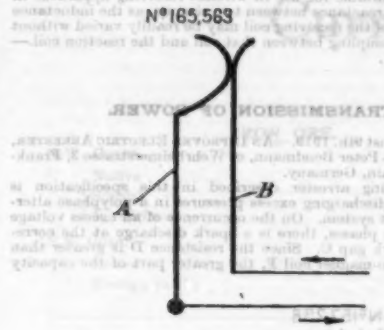
SWITCHGEAR.

165,563. January 13th, 1921.—Improvements in Electric Overload Circuit Breakers, Robert Alexander Ranéau Bolton, 60, Ranelagh-gardens, Barnes, London, S.W. 13.

The path of the current in the circuit breaker described in this specification is arranged so that its electro-dynamic effect tends to open the circuit when the contents are closed, and to blow out the arc when the contacts have parted. When the normal current passes through the circuit it has no effect, but when the current exceeds a certain value the repelling action of the current causes the circuit breaker to open. The device consists of a bar A forming the movable contact member and a second bar B serving as the fixed contact member. On the upper end of the movable bar A is a laterally projecting contact

piece which also serves to space the members A and B apart. The contact members are bent at their upper ends so as to serve

N°165,583



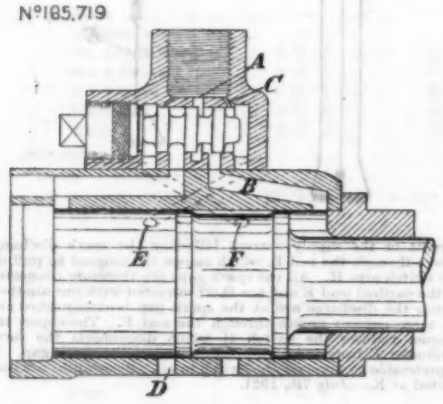
as horns between which the arc is blown out when the circuit is broken.—*July 7th*, 1921.

MACHINE TOOLS AND SHOP APPLIANCES.

165,719. February 8th, 1921.—Rock Drills, G. H. T. Rayner, 14, Broomhall-road, Sheffield, and P. Rayner, 38, Chantrey-road, Woodseats, Sheffield.

In this rock drill the valve is kept in position during the stroke of the piston by a reduced air pressure on its end. In the position shown air enters by the port A and passage B to drive the piston to the left. Air also goes to the end of the valve chamber by the

N°165,719



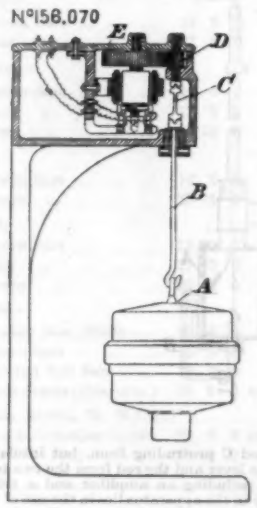
small port C and is led away to the exhaust D by the passage E. Sufficient pressure is, however, maintained in the chamber to keep the valve in place. When the piston uncovers the port of the passage F high pressure is admitted to the other end of the valve chamber and throws over the valve, while D and E are kept in communication by the recess round the piston.—*July 7th*, 1921.

MISCELLANEOUS.

156,070. December 26th, 1919.—Means for Electrically Driving the Bowls of Centrifugal Separators, Alfred Melotte, Remicourt, Belgium.

The object of the present invention is to enable the electric motor to be readily removed by detaching the cover of the

N°156,070

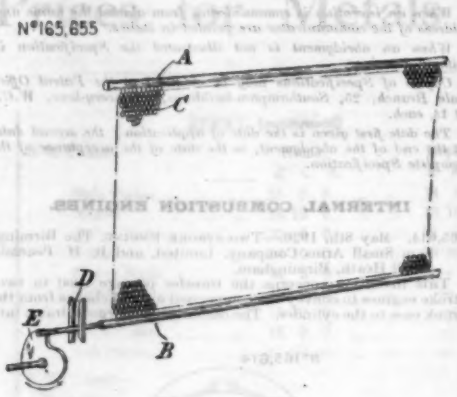


machine. The bowl A is suspended by a shaft B, which, by a joint C, is connected to a toothed pinion D, to which a rapid rotation is imparted by a toothed wheel E, connected to the motor armature.—*July 7th*, 1921.

165,655. June 21st, 1920.—Improvements relating to Electrostatic Plant for Depositing Dust and Particles from Gases, The Skinningrove Iron Company, Limited, and Thomas Richard Smith, both of the Skinningrove Works, Saltburn-by-the-Sea, York.

It has been found that during the operation of plants of the above kind the deposited dust tends to choke up the meshes of the electrodes and thus prevent the passage of the gases through them. According to this invention a stationary bar A has a curtain of inter-engaging links suspended from it and constituting a kind of chain-mail C, while a bar B at the bottom hangs from this chain-mail. The ends of the bar B are passed between guides D and are adapted to be lifted and dropped at intervals in any suitable manner, as, for example, by rotating cams E. A series of electrodes made in this manner may be arranged to be shaken in succession by means of cams driven through suitable gearing so that the load on the cam shaft is distributed.

N°165,655

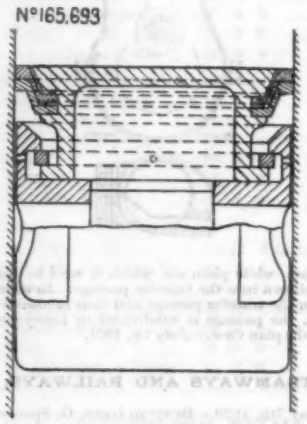


and each electrode is shaken in turn sufficiently often to prevent choking of the passage through which the gases pass.—*July 7th*, 1921.

165,693. September 4th, 1920.—Piston Rings, W. E. Philbrow, 8, Ibrox-place, Whitefield-road, Glasgow.

These piston rings are of a Z-shaped section, as shown. The rings are split radially and the cuts in the two are staggered. It

N°165,693

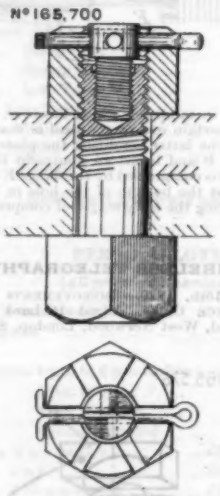


will be noticed that the pressure on the top of the rings tends to force them into closer contact with the cylinder walls on account of the diagonal direction of the webs joining the two flanges.—*July 7th*, 1921.

165,700. September 24th, 1920.—Lock Nuts, G. Shaw, 34, Carlton-road, Ashton-under-Lyne, near Manchester, and T. E. Thorp, Belmont, Norman-road, Stalybridge.

This nut lock takes the form of a stud, screwed into the end of

N°165,700



the bolt, with a thread of the opposite hand to that on the bolt. A split pin is passed through a hole in the stud and through slots in the nut.—*July 7th*, 1921.

LAUNCHES AND TRIAL TRIPS.

City of Pittsburg, geared turbine steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of the Ellerman Lines, Limited; dimensions, 485ft. 9in. by 58ft. 6in. by 34ft. 6in.; to carry 12,100 tons deadweight. Engines, single-screw double-geared turbines, pressure 225 lb. per square inch; constructed by the builders; launch, Thursday, July 21st.

Acklam; built by J. Samuel White and Co., Limited, to the order of Albert Chester, of Middlesbrough; dimensions, 204ft. by 30ft. 7in. by 14ft. 8in.; to carry 1100 tons deadweight. Engines, triple-expansion, 16in., 27in., and 44in. by 30in. stroke, pressure 180 lb.; constructed by the builders; launch, Thursday, July 21st.

Plum Branch; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of Nautilus Steam Shipping Company, Limited; dimensions, 398ft. 6in. by 53ft. 8in. by 28ft. 5in.; to carry 7000 tons deadweight. Engines, double reduction geared turbines, pressure 200 lb.; constructed by the builders; trial trip, Thursday, July 28th.

Texel, steel screw steamer; built by the Rotterdam Drydock Company (Rotterdamsche Droogdok Maatschappij), to the order of the Stoomvaart Mij. Triton; dimensions, 375ft. by 51ft. 6in. and 27ft. 6in. moulded depth; to carry 7100 tons, with a grain cargo capacity of 402,000 cubic feet or of 368,000 cubic feet piece goods. Engines, triple-expansion, 2100 indicated horse-power, 25in., 41in. and 68in. by 45in. stroke, pressure 180 lb. per square inch; constructed by the builders; three boilers arranged for burning either coal or oil fuel; Howden's system of forced draught fitted; trial trip, July 27th.

Tugela, steel screw steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of Wilh. Wilhelmsen, of Tonsberg; dimensions, 380ft. by 52ft. 3in. by 28ft.; to carry 7500 tons deadweight on a load draught of 25ft. Engines, triple-expansion, 27in., 44in., and 73in. by 48in. stroke; constructed by the builders; steam supplied by three boilers; Howden's forced draught fitted; trial trip, Friday, August 5th.

War Idyll; built by Monmouth Shipbuilding Company, Limited; dimensions, 411ft. 6in. by 55ft. 5¼in. by 36ft. 0¼in.; to carry 10,800 tons deadweight on draught of 28ft. Engines, high-pressure and low-pressure turbines of Westinghouse-Rateau type, pressure 200 lb.; constructed by the builders; launch, Saturday, August 6th.

Forthcoming Engagements.

TUESDAY, AUGUST 16TH.

Keighley Association of Engineers.—Visit to works of F. Wigglesworth and Co., Limited, Saltaire. Train leaves Keighley (M.R. 1.53 p.m.

MONDAY TO SATURDAY, SEPTEMBER 5TH TO 10TH.

Iron and Steel Institute.—Autumn meeting in France.

WEDNESDAY, SEPTEMBER 7TH TO 14TH.

British Association.—Annual meeting in Edinburgh. For programme see page 154.

WEDNESDAY, THURSDAY AND FRIDAY, SEPTEMBER 21ST, 22ND, AND 23RD.

The Institute of Metals.—Autumn meeting in Birmingham. For programme see page 151.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Webb Lamp Company, Limited, has decided to remove its head offices from 33, King-street, St. James'-square, London, S.W. 1, to 61, Aston-street, Birmingham.

We are asked to state that Mr. A. L. Tester, A.M.I. Mech. E., who joined the firm of Williams and Williams, Limited, of Chester, towards the end of last year, has just been appointed sales manager to Mr. B. A. Williams, managing director. Mr. Tester will control the sales organisation from the Sardinia House office in Kingsway, London, W.C. 2.

We are informed that the Magneta Time Company, Limited, has acquired the control of the Standard Time Company, Limited, 19–21, Queen Victoria-street, E.C., and that the "Magneta" directors have personally acquired the control of the Lowne Electric Clock and Appliances Company, Limited, 108, Bromley-road, Catford, S.E., and of the Silent Electric Clock Company, Limited, 192, Goswell-road, E.C. 1.

We are asked to state that the Canadian Chicago Bridge and Iron Company, Limited, of Bridgeburg, Ontario, and Montreal, Quebec, has changed its corporate name to Horton Steel Works, Limited. The new name has been selected in honour of the late Horace E. Horton, who founded the organisation in the United States in 1865. The Canadian organisation was first incorporated in 1913, and the plant at Bridgeburg, Ontario, was constructed in that year. The name of the parent company, the Chicago Bridge and Iron Works, 37 W., Van Buren-street, Chicago, Illinois, has not been changed.

Contracts.—Stothert and Pitt, Limited, of Bath, have been instructed by the proprietors of Fenning's Wharf—Hay's Wharf, Limited—to build for their Willson's Wharf three somewhat similar cranes to those mentioned in our issue of June 24th as being erected at the former wharf. The new cranes, as were the former, will be constructed on the "Toplis" patent horizontal luffing system.—In January last one turbine furnace was ordered from the Turbine Furnace Company, Limited, by the Garswood Collieries, Limited, of Bryn, near Wigan. On the 3rd inst. the firm received an order from the same company to supply fifteen sets of turbine furnaces for Lancashire boilers. The Raglan Collieries, Limited, of Pencoed, near Bridgend, have placed an order for one set of turbine furnaces for a Lancashire boiler.

Indian Jute and Silk.—An interesting volume on Indian jute and silk has just been published by Mr. John Murray—price 5s.—in the series of reports of the Indian trade inquiry, conducted at the Imperial Institute under the auspices of the Committee for India of the Institute. The first part of the volume deals with the results of an inquiry into the possibility of the increased commercial utilisation of jute and allied Indian fibres and contains three appendices, comprising, respectively statistical tables, summary of evidence of witnesses, and a copy of a report of the Committee of the Indian Jute Mills Association on the subject of trade after the war. India at present has a monopoly in the production of jute, and the recommendations of the Imperial Institute Committee refer chiefly to the question of keeping the trade in the fibre and its utilisation within the Empire, and of improving the quality and yield. The portion of the volume devoted to silk consists of two parts:—(1) A report on the question of the prospects of an increased utilisation of Indian silk within the Empire, and (2) a detailed statement prepared at the Imperial Institute on the silk trade of the world. The production of raw silk in India is at present insufficient to meet local needs, and large quantities of both raw silk and silk yarn are imported for use in the Indian mills. The opinion is expressed, however, that the enhanced value of Indian silk which would result from a radical improvement in its quality and standard of reeling, should render it possible for the Indian product to compete successfully with Japanese and Chinese silks. The types of silk, both cultivated and wild, which are most likely to find a market in the United Kingdom are indicated.